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FOURMILE HILL GEOTHERMAL DEVELOPMENT PROJECT

Environmental Impact Statement
Environmental Impact Report

Volume I: Final EIS/EIR

State Clearinghouse No. 96062042

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

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DEPARTMENT OF AGRICULTURE

County of Siskiyou
AIR POLLUTION CONTROL DISTRICT

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Forest Service
U.S. Department of Agriculture

Bureau of Land Management
U.S. Department of the Interior

Dear Reader:

Attached is the Final Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the proposed Fourmile Hill Geothermal Development project. This Final EIS/EIR includes some additional information not included in the Draft EIS/EIR, as well as responses to all public comments and statements made at the five public hearings held on the project and written comments received on the Draft EIS/EIR.

The Bureau of Land Management (BLM) and the Forest Service served as lead federal agencies and the Siskiyou County Air Pollution Control District (APCD) served as the state lead in the preparation of this document. Bonneville Power Administration was a cooperating agency. The joint document was prepared pursuant to the requirements of the National Environmental Policy Act and the California Environmental Quality Act.

The attached environmental document represents the joint Final EIS/EIR. The Final EIS/EIR will be used by BLM, Forest Service and APCD to decide the various discretionary actions required to implement the project. The BLM's and the Forest Service's decisions will be identified in a Record of Decision. Statements on the EIS/EIR or the project will be accepted by the agencies and considered in arriving at our decision on this proposed action.

The Final EIS/EIR is distributed for a 30-day notification period that begins October 2, 1998 and ends November 2, 1998. Written information regarding the Final EIS/EIR should be submitted to the following address:

Randall M. Sharp, BLM/Forest Service Project Coordinator
800 W. 12th Street
Alturas, CA 96101

A public hearing will be held by the Siskiyou County Air Pollution Control District Board regarding the certification of the document in respect to satisfying the requirements of the California Environmental Quality Act. A separate notification will be issued for that hearing.

We wish to thank those who have contributed time and knowledge to this project. We appreciate your interest and your commitment to participating in this project.

Sincerely,

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Acting Forest Supervisor
Klamath National Forest

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FOURMILE HILL GEOTHERMAL DEVELOPMENT PROJECT

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September 1998

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U.S. Department of Interior
Bureau of Land Management
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Final EIS/EIR
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EXECUTIVE SUMMARY

The Executive Summary includes a description of the purpose and need for the proposed project and alternatives, a summary of key issues raised by the public during the comment period, and a summary of the environmental impacts of the proposed project.

VOLUME I: FINAL EIS/EIR

1: Introduction and Purpose and Need
2: Alternatives, Including the Proposed Project
3: Description of the Affected Environment
4: Environmental Consequences and Mitigation Measures
5: Mitigation Monitoring and Reporting Program
6: List of Preparers and Agencies and Persons Contacted
7: References
8: Index

Volume I of the Final EIS/EIR includes the revised text of the Draft EIS/EIR. The revisions to the document include errata, staff-initiated changes, and additional clarifications, as identified in the responses to public comments.

VOLUME II: FINAL EIS/EIR APPENDICES

A: Mailing List for Draft and Final EIS/EIR
B: Scoping Materials
C: Biological Resources
D: Visual Resources
E: Meteorological Data
F: Air Quality Impact Assessment

Volume II includes the appendices that were included in the Draft EIS/EIR. The appendices have been provided as a separate volume due to the increased size of the EIS/EIR. Similar to Volume I, Volume II reflects revisions due to errata, staff-initiated changes, and additional clarifications.

VOLUME III: FINAL EIS/EIR RESPONSES TO COMMENTS ON THE DRAFT EIS/EIR

1: Introduction
2: Agencies, Organizations, and Persons Commenting on the Draft EIS/EIR
3: Responses to Comments on the Draft EIS/EIR
4: Responses to NEPA/CEQA Issues Comments
5: Responses to Project Preference Comments
6: Responses to General Comments
7: Comment Index
8: Index

Volume III presents all public comments on the Draft EIS/EIR as well as comments on other issues, and the agency responses to all of these comments. Public comments were submitted in writing, and heard verbally at public hearings that were held for the Draft EIS/EIR. Individual comments have been organized by parameter in order to provide complete response on all issues.

VOLUME IV: FINAL EIS/EIR COMMENTS ON THE DRAFT EIS/EIR

1: Original Comment Letters
2: Comment Index

Volume IV provides copies of the original comment letters that were received on the Draft EIS/EIR. This volume also includes copies of the transcripts from the Draft EIS/EIR public hearings.

Volume I: Final EIS/EIR
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Fold-Out Project Map ..... Inside Back Cover

KEY TO ACRONYMS

ACRONYM	DEFINITION
AAQS	Ambient Air Quality Standard
AC	Alternating Current
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
AIRFA	American Indian Religious Freedom Act
AMA	Adaptive Management Area
ANSI	American National Standards Institute
APCD	Air Pollution Control District
APLIC	Avian Power Line Interaction Committee
AQMD	Air Quality Management District
ATC	Authority to Construct
BACT	Best Available Control Technology
BEA	Bureau of Economic Analysis
bgs	Below Ground Surface
BLM	U.S. Department of the Interior, Bureau of Land Management
BOPE	Blowout Prevention Equipment
BPA	Bonneville Power Administration
°C	Degrees Celsius
CA	California
CAA	Clean Air Act
CalEnergy	CalEnergy Company, Inc.
Cal EPA	California Environmental Protection Agency
CAPCOA	California Air Pollution Control Officers' Association
CARB	California Air Resources Board
CCAA	California Clean Air Act
CCR	California Code of Regulations
CDF	California Department of Forestry
CDFG	California Department of Fish and Game
CDMG	California Division of Mines and Geology
CDOG	California Division of Oil and Gas
CEGC	California Energy General Corporation
CEQ	Council of Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CHP	California Highway Patrol
cm/sec	Centimeter per Second
CNDDB	California Natural Diversity Data Base
CNPS	California Native Plant Society

CO	Carbon Monoxide
CO_2	Carbon Dioxide
COTP	California-Oregon Transmission Project
CPUC	California Public Utilities Commission
CVRWQCB	Central Valley Regional Water Quality Control Board
CWF	Circulating Water Flow
CWHR	California Wildlife Habitat Relationships System
dB	Decibel
dBA	Decibels A-weighted
dbh	Diameter Breast Height
DC	Direct Current
DLG	Digital Line Graph
DWR	Department of Water Resources
EA	Environmental Assessment
EHR	Erosion Hazard Rating
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EMF	Electromagnetic Field
EPA	U.S. Environmental Protection Agency
°F	Degrees Fahrenheit
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FESA	Federal Endangered Species Act
FHWA	Federal Highway Administration
FLPMA	Federal Land Policy and Management Act of 1976
FMRP	Freeport-McMoRan Resource Partners
FONSI	Finding of No Significant Impact
FTB	Fluidized Thermal Backfill
FWARG	Far Western Anthropological Research Group, Inc.
GERA	G.E. Raleigh & Associates
g/MW-hr	Grams per Megawatt-hour
gpm	Gallons per Minute
gr/ACF	Grains per Actual Cubic Foot
GRO	Geothermal Resources Operational Order
GUP	Geothermal Utilization Permit
H_2S	Hydrogen Sulfide
H_2SO_4	Sulfuric Acid
HDPE	High Density Polyethylene
HI	Hazard Index
HPFF	High Pressure Fluid Filled
hz	Hertz
I-5	Interstate 5
IP	Interested Parties
IRPA	International Radiation Protection Association
IS	Initial Study
ISO	International Standards Organization
K	Soil-Erodibility Factor
KGRA	Known Geothermal Resource Area
Khz	KiloHertz
km	Kilometer

KOP	Key Observation Point
kph_m	Thousand Pounds per Hour, Mass Flow
kV	Kilovolt
L_{dn}	Day-Night Average Noise Level
L_{eq}	Average Hourly Equivalent Sound Level over a 24-hour Period
lb/day	Pounds per Day
LRMP	Land and Resource Management Plan
MCL	Maximum Contaminant Level
MDB&M	Mount Diablo Base and Meridian
mG	Milligauss
MIS	Management Indicator Species
MLSA	Managed Late Successional Area
mm	Micrometer
MMRP	Mitigation Monitoring and Reporting Program
MOU	Memorandum of Understanding
mph	Miles per Hour
MSDS	Material Safety Data Sheets
m/sec	Meters per Second
msl	Mean Sea Level
MW	Megawatt
n/a	Not Available
NAGPRA	Native American Graves Protection and Repatriation Act
NAWS	Naval Air Weapons Station
NCRWQCB	North Coast Region Water Quality Control Board
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
No.	Number
NO	Nitric Oxide
NO_X	Nitrogen Oxides
NO_2	Nitrogen Dioxide
NOI	Notice of Intent
NOP	Notice of Preparation
NPAB	Northeast Plateau Air Basin
NPS	National Park Service
NRHP	National Register of Historic Places
NSR	New Source Review
O_2	Molecule of Oxygen
O_3	Ozone
OEPC	Office of Environmental Project Compliance
OSHA	Occupational Safety and Health Act
Pb	Lead
PDEIS	Preliminary Draft Environmental Impact Statement
PG&E	Pacific Gas and Electric Company
PM_{10}	Particulate Matter Less Than 10 Microns
POO	Plan of Operation
POU	Plan of Utilization
ppb	Parts per Billion
ppm	Parts per Million
ppm_w	Parts per Million by Weight

PSD	Prevention of Significant Deterioration
PST	Pacific Standard Time
PTO	Permit to Operate
PUHCA	Public Utility Holding Company Act
PURPA	Public Utility Regulatory Policies Act
RCRA	Resource Conservation and Recovery Act
REL	Reference Exposure Level
Rh	Relative Humidity
RMA	Recreation Management Area
ROD	Record of Decision
ROG	Reactive Organic Gases
ROS	Recreation Opportunity Spectrum
ROW	Right-of-Way
RV	Recreational Vehicle
RWQCB	Regional Water Quality Control Board
SCAPCD	Siskiyou County Air Pollution Control District
SCEC	Soil Conservation and Erosion Control Plan
SCFF	Self Contained Fluid Filled
SCS	Soil Conservation Service
SD	Solid Dielectric
SHPO	State Historic Preservation Office
SIA	Special Interest Area
SL	Site License
SNARL	Suggested No-Adverse-Response Level
SO_x	Sulfur Oxides
SO_2	Sulfur Dioxide
SO_4	Sulfate Component of PM_{10}
TOG	Total Organic Gases
$\mu g/m^3$	Micrograms per Cubic Meter
URF	Unit Risk Factor
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of the Interior
USFS	U.S. Department of Agriculture, Forest Service
USFWS	U.S. Department of the Interior, Fish and Wildlife Service
USGS	U.S. Department of the Interior, Geological Survey
UTM	Universal Transverse Mercator
v/M	Volts per Meter
VMS	Visual Management System
VQO	Visual Quality Objective
VRM	Visual Resources Management
wf/pp	Wellfield and Power Plant Area
WHR	Wildlife Habitat Relationship

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Calpine Corporation has submitted a Plan of Utilization (POU) to the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) to develop a 49.9 megawatt (MW) geothermal power plant and wellfield and 24-mile, 230-kilovolt (kV) transmission line. This project, known as the Fourmile Hill Geothermal Development Project, would be located in the Glass Mountain Known Geothermal Resource Area (KGRA) on the Klamath and Modoc National Forests, in Siskiyou and Modoc Counties, California (Figures S-1, S-2, and S-3). The Glass Mountain KGRA represents one of the only remaining undeveloped KGRAs in North America with a demonstrated geothermal resource.

Purpose and Need

The purpose of the Fourmile Hill Geothermal Project is to develop the geothermal resource on Calpine's Federal geothermal leases in order to economically produce and deliver electrical energy to the Bonneville Power Administration (BPA) and others. The need for the project was stated by the U.S. Geothermal Steam Act of 1970, the Geothermal Energy Research, Development, and Demonstration Act of 1974, the Federal Land Policy and Management Act (FLPMA) of 1976, and the Energy Policy Act of 1992. The proposed project is consistent with these Federal regulations which seek to foster and encourage private enterprise in the development of alternative energy resources.

Lead Agencies Roles and Approvals

ROLES

The proposed project is under the jurisdiction of the BLM and the U.S. Forest Service (USFS) as the Federal lead agencies under the National Environmental Policy Act (NEPA). The Siskiyou County Air Pollution Control District (APCD) is the California Environmental Quality Act (CEQA) lead agency. BPA is participating as a cooperating Federal agency. These agencies are overseeing the preparation of this Environmental Impact Statement/Environmental Impact Report (EIS/EIR) under NEPA and CEQA.

This document is being prepared as a joint EIS/EIR in order to streamline the Federal and state environmental review processes. The lead agencies determined that a third-party contractor was needed to assist in the preparation of the EIS/EIR in order to meet the project timelines. MHA Environmental Consulting, Inc. (MHA) was selected by the

Figure S-1: Regional Location Map

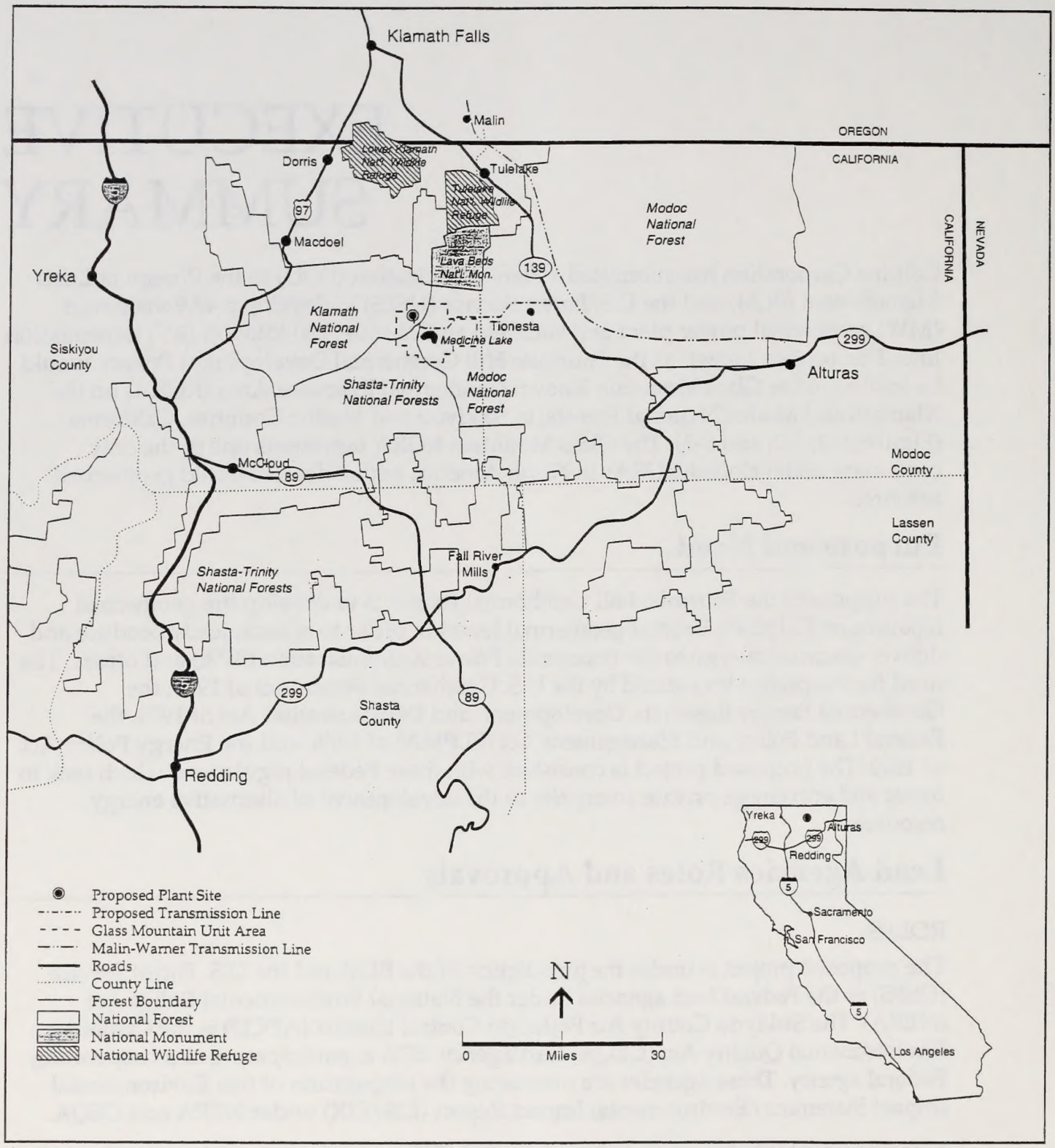
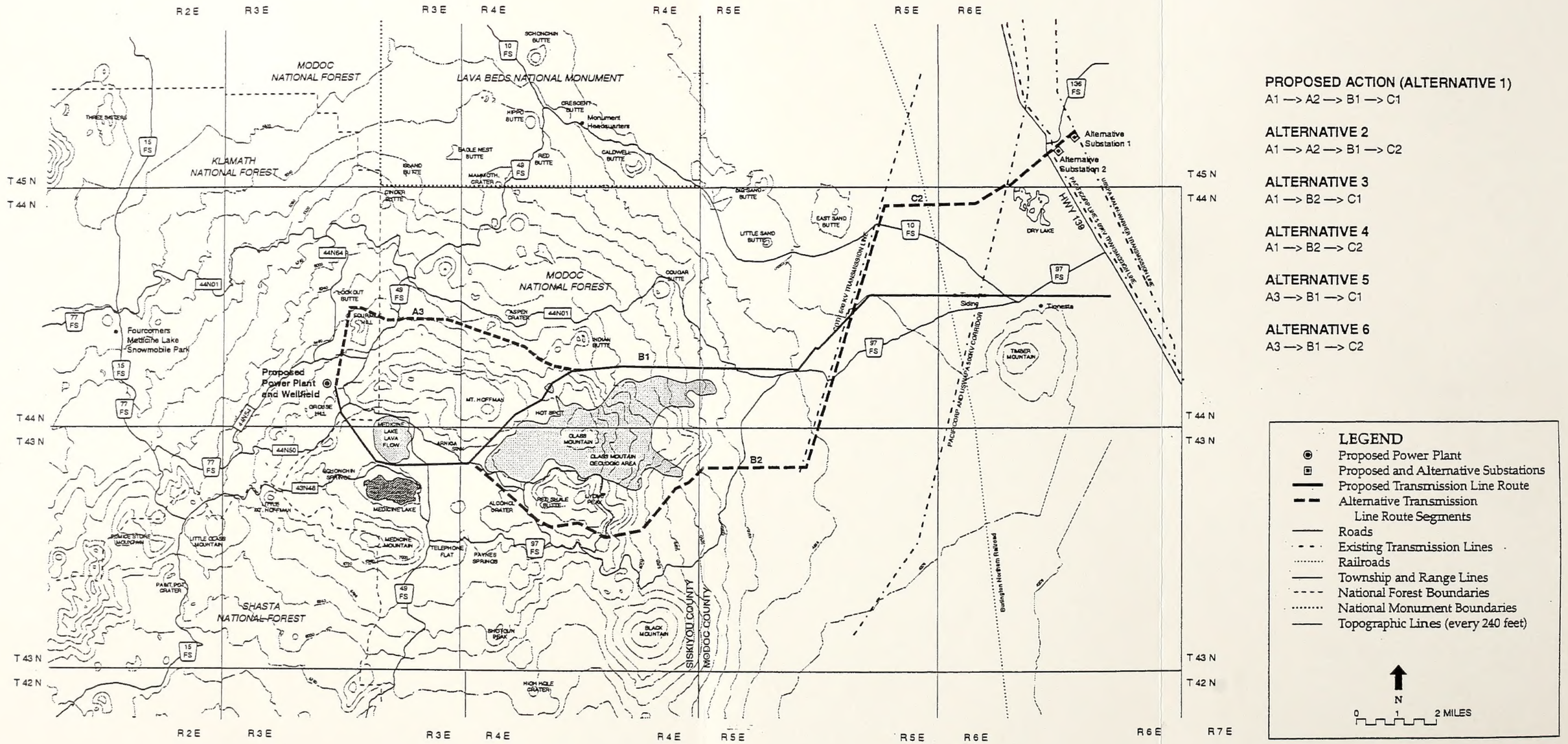


Figure S-2: Proposed Power Plant and Transmission Line Routes



PROPOSED ACTION (ALTERNATIVE 1)
A1 —> A2 —> B1 —> C1

ALTERNATIVE 2
A1 —> A2 —> B1 —> C2

ALTERNATIVE 3
A1 —> B2 —> C1

ALTERNATIVE 4
A1 —> B2 —> C2

ALTERNATIVE 5
A3 —> B1 —> C1

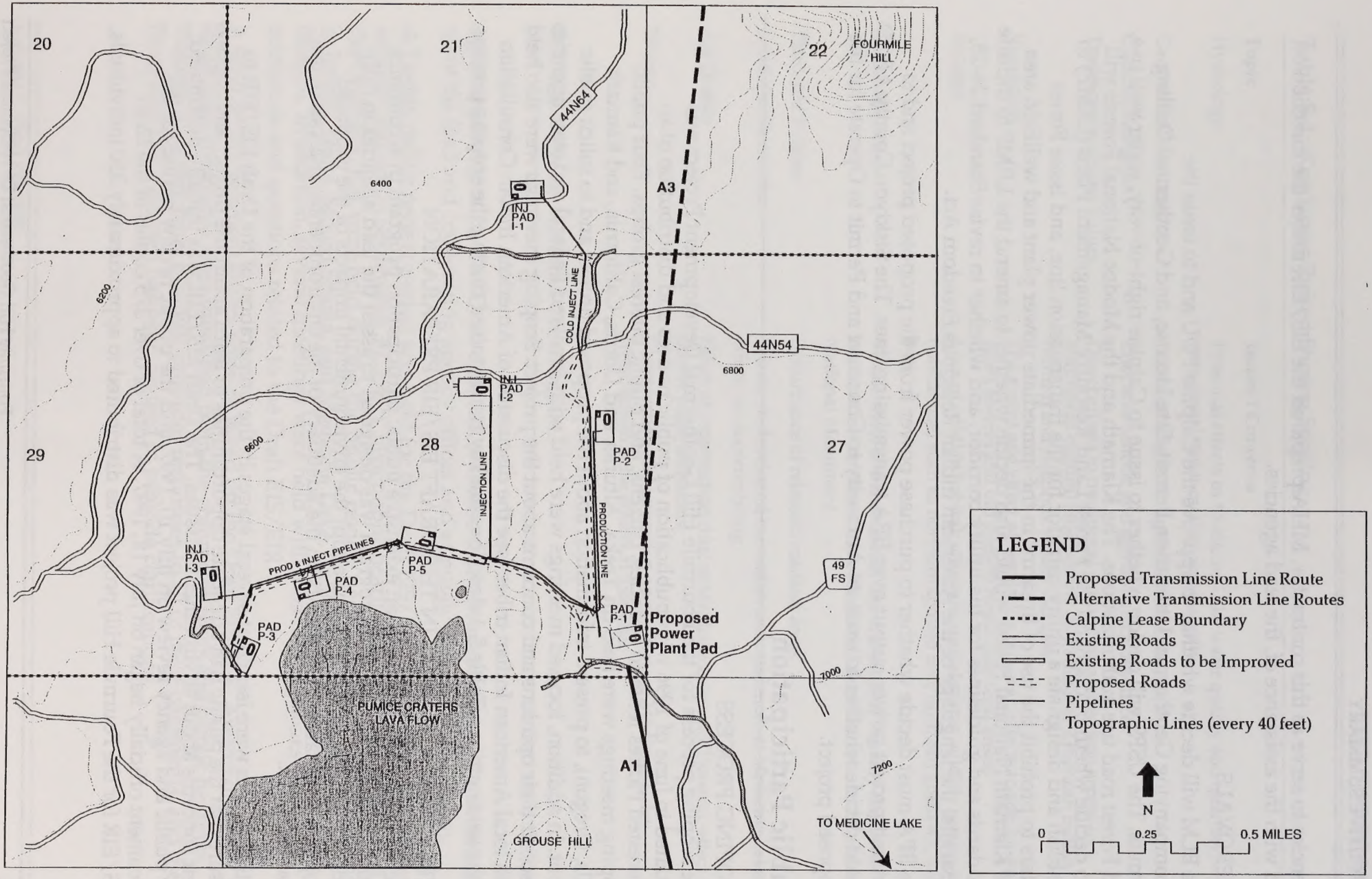
ALTERNATIVE 6
A3 —> B1 —> C2

LEGEND
- Proposed Power Plant
- Proposed and Alternative Substations
- Proposed Transmission Line Route
- Alternative Transmission Line Route Segments
- Roads
- Existing Transmission Lines
- Railroads
- Township and Range Lines
- National Forest Boundaries
- National Monument Boundaries
- Topographic Lines (every 240 feet)

N

0 1 2 MILES

Figure S-3: Power Plant and Wellfield Area



MHA *Environmental Consulting, Inc.*

SOURCE: Calpine

agencies to serve as this contractor. MHA prepared the EIS/EIR under the direction of, and with the assistance of, the lead agencies.

APPROVALS

The BLM will decide whether to approve the Calpine POU and to issue the accompanying Geothermal Utilization Permit, Site License, and Geothermal Drilling Permits. The USFS will decide whether to issue to Calpine right-of-way, water well use, and Forest road use authorizations. The Klamath and the Modoc National Forests will also decide whether to amend the Forest Land Resource Management Plans (LRMP) to establish and designate a utility corridor for the transmission line, and issue Forest orders to prohibit the use of firearms in the immediate power plant and wellfield area. The Klamath National Forest would also decide whether to amend the LRMP to include standards and guidelines for the utility corridor, and whether to revise Standard 24-25, to parallel the language of the American Indian Religious Freedom Act.

The BPA must decide whether to purchase power from the proposed project and to transmit project power output over BPA transmission lines. The Siskiyou County APCD would decide whether to issue an Authority to Construct and Permit to Operate for the proposed project.

Public Participation

SCOPING PROCESS

The scoping process for the Fourmile Hill Geothermal Development Project was initiated in June of 1996 with publication of public notices and distribution of an Interested Parties letter to agencies, citizens, and public interest groups. Four public scoping meetings were held (in Yreka, Alturas, and Dorris, California, and Klamath Falls, Oregon), to present information about the proposed project and to solicit public input. In addition, focused meetings were held with involved Federal and state agencies to solicit their opinions and concerns about the project. Scoping meetings were also held with local American Indian tribes (see the discussion of American Indian Consultation in the next section). Table S-1 describes the key issues raised during the scoping process.

PUBLIC PARTICIPATION IN THE DRAFT EIS/EIR PREPARATION

The lead agencies conducted an extensive public participation program in accordance with NEPA and CEQA. The program was designed to assist the lead agencies in fully addressing the public's concerns about the environmental impacts of the proposed project, and obtaining comments on the adequacy of the environmental analysis in the Draft EIS/EIR.

Public notices were issued at several stages in the preparation of the Draft EIS/EIR to ensure that the public had adequate opportunities to learn about the project and express their concerns about environmental issues. The Draft EIS/EIR was initially distributed for public and agency review on July 10, 1997, and the public review period for the document officially began on July 18, 1997. A total of over 375 copies of the Draft EIS/EIR for the Fourmile Hill project was distributed to approximately 330 individuals,

Table S-1: Key Issues Raised During Scoping

Topic	Issues / Concerns
Hydrology	Potential effects to Medicine Lake water quality and quantity; effects to regional water quality and quantity
Geothermal Resources	Potential effects to regional thermal features
Cultural Resources	Effects to historic and archaeological resources
Traditional Cultural Values	Direct effects to traditional cultural sites; effects on access to traditional cultural sites; effects on traditional American Indian cultural and religious values and uses
Vegetation	The extent and effect of vegetation removal; effects to special-status plant species and old growth forest (late seral areas)
Wildlife	Loss of wildlife habitat; effects to special-status wildlife species (and habitat use) such as northern spotted owl, northern goshawk, and bats
Visual Resources	Visual effect of transmission line crossings of visually sensitive roads; effect on views from Medicine Lake, Tionesta, and Lava Beds National Monument
Plans and Policies	Disturbance of released roadless areas
Land Use/Recreation	Effects on developed recreation and residences at Medicine Lake; effects on snowmobiling
Air Quality	Effect of construction dust at Medicine Lake and Tionesta; effect of power plant emissions
Noise	Construction and operation noise effects at Medicine Lake; construction noise effects at Tionesta

SOURCE: MHA Environmental Consulting, Inc.

agencies, and groups. The Draft EIS/EIR was also made available for public review at all of the lead and cooperating agency offices and at public libraries in the region.

A 74-day public review period was held for the Draft EIS/EIR (the review period was officially closed on September 30, 1997). Five public hearings to receive comments on the Draft EIS/EIR were held during the public review period. These hearings were held at Dorris, Yreka, Mount Shasta, and Medicine Lake, California, and at Klamath Falls, Oregon. In addition, several meetings were held with interested agencies to discuss comments and questions related to the Draft EIS/EIR.

A total of 270 comment letters were received on the Draft EIS/EIR. Approximately 2,300 individual comments were identified from the comment letters and public hearings. Volume III of this Final EIS/EIR provides responses to all of these comments, and the Final EIS/EIR Volume I has been revised to provide clarifications.

SUMMARY OF KEY COMMENT TOPICS ON THE DRAFT EIS/EIR

This section summarizes the topics of public and agency comments on the Draft EIS/EIR, and the key clarifications and revisions made in this Final EIS/EIR. Key issues and concerns raised by the public are identified, and how these issues and concerns are addressed in the responses is summarized. In addition, information that has become available since the release of the Draft EIS/EIR is summarized; the added information supports the conclusions that were drawn in the Draft EIS/EIR. No new impacts have been identified, and no changes have been made to significance determinations. For detailed comments and responses, see Chapter 3 of Volume III of the Final EIS/EIR.

Introduction and Purpose and Need

The topic areas of comment on introduction and purpose and need issues were:

- Purpose and Need for the Proposed Action
- Agency Roles and Authorizations
- Other Required Permits and Approvals
- Previous Geothermal Activities
- Geothermal Definition
- Economic Justification for and Viability of the Proposed Action

Several commentors questioned the purpose of the project and whether there is a demonstrated need for the project. Many of these commentors also requested information on the economic justification for the proposed action, and questioned the viability of project. Some commentors requested clarification about the roles and approvals of the lead agencies, as well as other permits and approvals. Commentors also asked about previous geothermal exploration activities in the vicinity, as well as the environmental documentation and public notification for these activities. The definition of geothermal power as renewable or "green" power was questioned.

The responses further explain the purpose and need for the project, and provide additional support for the purpose and need. Neither NEPA nor CEQA require that economic justification for a project be provided, and this information has not been presented in the Final EIS/EIR since it is proprietary. The responses further explain the lead agencies roles and approvals, and clarify the roles of the North Coast and Central Valley Regional Water Quality Control Boards (RWQCB). Additional details about previous geothermal exploration activities are provided, and environmental documentation and public notification for these activities is summarized. Finally, the responses further elaborate on the basis for considering geothermal to be a renewable or green resource.

Only minor text changes to the EIS/EIR resulted from the responses to comments on introduction and purpose and need issues. Information about the Draft EIS/EIR distribution, Draft EIS/EIR public review period, and additional interested parties meetings has been added to Chapter 1, Introduction and Purpose and Need, of the EIS/EIR.

Alternatives, Including the Proposed Action

The topic areas of comment on alternatives issues were:

- Project Description
- Well Testing, Design and Maintenance
- Transmission Line Design and Capacity
- Decommissioning
- Alternatives to the Proposed Action
- Alternatives Considered but Eliminated from Detailed Study

Several of the commentors raised questions about the size of the proposed project and the proposed drilling, testing, and maintenance of the geothermal wells. Other comments asked about the design, capacity and reliability of the proposed transmission line. Comments also raised concerns about the consideration of alternatives for the proposed action.

The responses clarify the size of the proposed project and the proposed protocol for the testing, drilling, and maintenance of the geothermal wells. A representative schematic cross-section of the proposed production wells is provided to further illustrate the integral strength of these wells. The proposed design, capacity, reliability, routing, and decommissioning of the transmission lines are further explained in the responses. Responses also provide clarification on the development and consideration of alternatives to the proposed action.

Geology and Soils

The topic areas of comment on geology and soils issues were:

- General
- Potential Effects to Caves
- Geologic Hazards
- Potential Effects to Soils

Several commentors questioned whether the proposed project would increase seismic or volcanic activity in the area. Other commentors questioned whether the project would affect the stability of slopes or create landslides or ground subsidence. Some commentors questioned the effects on soils from either erosion or deposition of air emissions.

The responses explain that the proposed project may induce microearthquakes that could not be felt by humans and that volcanic activity would not increase. The responses also highlight the erosion-control measures that are part of the project that would minimize soil erosion and eliminate the chance of landslides. The substrate in the area is stable and would not experience substantial ground subsidence.

Hydrology

The topic areas of comment on hydrology issues were:

- General
- Regulatory Information

- Local Groundwater and Effects from Groundwater Use
- Local Groundwater and Effects from Geothermal Fluid Use
- Regional Groundwater
- Surface Waters and Effects from Construction Activities
- Surface Waters and Effects from Groundwater Use
- Surface Waters and Effects from Geothermal Fluid Use
- Surface Waters and Effects from Deposition
- Hydrology Mitigation
- Hydrology Monitoring Plan

The responses to comments on hydrology is one of the longest sections in the Final EIS/EIR. The majority of commentors questioned the impacts of the proposed project from the use of either groundwater or geothermal fluids or from the deposition of air emissions. Most commentors questioned whether these uses would affect groundwater, the geothermal reservoir, or surface water, either locally (i.e., in the project area) or regionally. There were many commentors who asserted that the project could affect the water quantity or quality of the springs at Fall River.

The responses provide an extensive discussion of the project's use of both geothermal fluids and groundwater and how this use might affect each resource, both locally and regionally. Additional data are provided to support the conclusions in the Draft EIS/EIR regarding the potential hydrologic impacts of the project. In addition, there is an extensive discussion of the potential effects of air emissions on surface waters in the vicinity of the project.

Because of the number of commentors who asserted that the project would have an adverse effect on the Fall River springs, the response to these comments is extensive. Several hydrology reports were prepared subsequent to release of the Draft EIS/EIR that support the Draft EIS/EIR conclusions about the lack of potential for significant effect. The response to Fall River springs comments summarizes the conclusions drawn earlier in the hydrology section and provides additional support for the conclusion that the project would not have a measurable effect on the springs at Fall River.

The deposition analysis in the Draft EIS/EIR was revised in response to refinement of the estimates of air emissions from the project. In addition, the revised analysis incorporated a new, more realistic assumption into the model. The results of this revised analysis did not change the conclusions in the Draft EIS/EIR. In response to these comments, several mitigation measures were revised to clarify their intent.

Calpine collected water samples from local surface waters in the area (including Medicine Lake) in November 1997. The water quality analysis of these samples has been added to the Draft EIS/EIR. Calpine has also developed a water quality monitoring program in the power plant and wellfield area since publication of the Draft EIS/EIR that has been preliminarily reviewed by the U.S. Environmental Protection Agency (EPA) and Central Valley and North Coast RWQCBs for adequacy. Details of this program are also included in the responses and in the Final EIS/EIR.

Geothermal Resources

The topic areas of comment on geothermal resources issues were:

- Data on Geothermal Resource
- Effects on Life Expectancy of the Geothermal Resource
- Effects on Regional Thermal Features

Most commentors questioned either the chemical composition of the geothermal fluids or the life expectancy of the geothermal resource. Several commentors also questioned the temperature gradient data and expressed frustration that some of these data were proprietary and not available for public review. Other commentors expressed concern about potential effects of the project to the Hot Spot.

The responses clarify the chemical composition of the geothermal fluids and provide new information that became available after publication of the Draft EIS/EIR. The life expectancy of the geothermal resource would be adversely but not significantly affected by the project, as demonstrated by data from other geothermal fields that have been in operation for up to 50 years. Minor changes to the Draft EIS/EIR have been made to clarify this discussion.

The responses also clarify the nature of the temperature gradient data, and explain that a thorough review has been conducted of the proprietary data by third parties. The Hot Spot is a surface feature that has no direct connection with the geothermal reservoir and would therefore not be affected by the project.

Cultural Resources

The topic areas of comment on cultural resources issues were:

- General
- Section 106 Process
- Tribal Participation
- Survey Methodology
- Potential Impacts at the Power Plant and Wellfield Areas
- Potential Impacts Along the Transmission Line
- Mitigation Measures

The responses clarify the USFS implementation of the National Historic Preservation Act Section 106 process, confirm participation of the tribes in the process, and clarify the mitigation measures. The responses also explain that a Class III cultural resource inventory was conducted for the power plant and wellfield area. A Class III inventory of the transmission line would not be conducted prior to a decision on the project in order to avoid unnecessary effects to cultural resources, and to avoid the expense of surveying routes that are not selected. The Section 106 process will be completed prior to the agencies making a decision on the project in accordance with USFS policy.

Minor additions to the EIS/EIR were made to clarify that the entire wellfield and power plant area were inventoried for cultural resources and to clarify a mitigation measure.

Traditional Cultural Values

The main topics of comments on traditional cultural values issues were:

- General
- Importance of the Project Region
- Regulatory Compliance
- Impacts
- Mitigation Measures
- Ethnographic Report

Many commentors expressed opposition to the project based on the sanctity of the region. The commentors identified the Medicine Lake Highlands region and individual sites in the region as areas with religious and spiritual values. Commentors also questioned whether the project complied with the many laws pertaining to protection of cultural resources and Native American heritage, culture, and values. The commentors also identified project impacts to traditional use sites in the region (no new impacts were identified).

The responses acknowledge the traditional cultural values of the area and summarized the tribal participation in the environmental review process. The responses describe the various laws that apply to the project and the consistency with the laws. The responses to comments further clarify that the project would not prevent access to or use of traditional sites, but acknowledge the tribal comments that the project would have a significant adverse effect on the sites and the use of the sites.

Section 3.6, Traditional Cultural Values, in the EIS/EIR has been updated to reflect the second phase of the ethnographic study, which was conducted subsequent to the release of the Draft EIS/EIR. Phase II of the ethnographic study included additional literature review, additional tribal interviews, and field verification of traditional use sites identified in interviews.

Mitigation Measure 4.6.3b was expanded to further define noise control measures.

Vegetation

The topic areas of comment on vegetation issues were:

- General
- Effects of Emissions on Vegetation
- Other Effects on Vegetation
- Potential Impacts to Special-Status Plants
- Impacts to Specific Plant Communities
- Vegetation Mitigation

Many commentors expressed concern about the potential effects of air emissions on vegetation or about the effects of the project on specific plant communities such as wetlands. Other commentors questioned the adequacy of mitigation measures for impacts to special-status plants and to sensitive plant communities.

The responses clarify the analysis of the potential effect of air emissions on vegetation (particularly for boron) that was presented in the Draft EIS/EIR. Wetland habitats would not be affected by the project because the transmission line would be rerouted to avoid these habitats (there are no wetlands in the power plant and wellfield area). The responses also highlight the mitigation measures designed to avoid or reduce impacts to special-status plants and sensitive plant communities. Minor changes to several mitigation measures were made in response to comments in this section.

Wildlife

The topic areas of comment on wildlife issues were:

- General
- Potential Impacts to Special-Status Wildlife
- Impacts to Specific Special-Status Wildlife
- Wildlife Mitigation

The responses summarize the consultations with regulatory agencies to date and explained their role in environmental review process. The USFWS and CDFG have been frequently consulted regarding potential effects to threatened and endangered wildlife species. The Draft EIS/EIR did not include an exhaustive discussion of the habitat requirements of all wildlife because this information was included in biological reports already prepared (some specifically for this project), which were incorporated by reference. However, more information on some species' habitat requirements was provided in the responses.

A new mitigation measure was added to this section to ensure that wildlife would not come in contact with the contents of the sumps. The responses also discuss the amount of noise that would be generated by the project and the potential for this noise would disturb wildlife. Several mitigation measures were highlighted that reduce noise effects. The responses also clarify which roads would be open to the public and to hunting, which might adversely affect wildlife.

The responses provide additional support for the conclusion in the Draft EIS/EIR that the transmission line would not cause bird electrocution and would not significantly affect the chance of bird collisions. The special-status bird with the highest chance of colliding with the line is the sandhill crane. Mitigation in the EIS/EIR was modified to address this species. The responses also provide extensive discussion of the potential effects of the project on the bald eagle, osprey, northern spotted owl, and other raptors.

The Draft EIS/EIR was slightly modified to clarify the discussion of wildlife, particularly for bats. Several mitigation measures were clarified in response to comments in this section. Three other mitigation measures were added to this section that direct Calpine to conduct preconstruction surveys for special-status mollusks.

Visual Quality

The topic areas of comment on visual quality issues were:

- General
- Methodology

- General Impacts of Project Facilities
- Impacts from Specific KOPs
- Consistency with VQOs
- Mitigation Measures

Most of the comments raised concerns about the visual effect of night lighting, steam plumes, and the transmission line, particularly from vantage points in the vicinity of Medicine Lake. Other commentors were concerned about views of the project from Tionesta, Lava Beds National Monument, and the Little Mt. Hoffman Lookout. Some commentors questioned the determination of VQO consistency at various key observation points (KOPs). One commentor proposed an alternate method for analyzing visual effects.

The responses clarify the potential visual effect of the project at various KOPs, and further explain the VQO consistency of the project. The lighting control guidelines in Mitigation Measure 4.9.2c have been clarified, and an additional mitigation measure (Measure 4.9.5c) has been added to further reduce the potential for night-lighting effects in the Medicine Lake vicinity. Since the visual analysis method used in the Draft EIS/EIR provided a fair and representative evaluation of potential impacts, use of an alternate method for analyzing visual effects is not warranted.

The responses also explain that Alternative 6 has been identified in the Final EIS/EIR as the lead agencies' preferred alternative. This alternative would implement transmission line Segment A3 instead of Segments A1 and A2 (which are proposed as part of the proposed action). Alternative 6 would therefore avoid the significant unavoidable visual effects that would occur at Medicine Lake KOPs under the proposed action.

Plans and Policies

The topic areas of comment on plans and policies issues were:

- General
- Land and Resource Management Plans
- Northwest Forest Plan
- Released Roadless Areas

Many commentors asserted that the proposed project was not consistent with either the Klamath or Modoc Land and Resource Management Plan (LRMP). Other commentors questioned whether the proposed project was consistent with various aspects of the Northwest Forest Plan. Many commentors expressed a desire to designate portions of the project area as an "old-growth reserve." Many commentors also expressed concern about the potential impacts of the project on the Mt. Hoffman released roadless area.

The responses explain that the proposed project is consistent with the Klamath and Modoc LRMPs after mitigation. The Klamath LRMP would be amended to bring the plan into consistency with the American Indian Religious Freedom Act. The Klamath LRMP would also be amended to make the plan consistent with the Modoc LRMP regarding utility corridors. The responses also explain in detail how the project is consistent with the provisions of the Northwest Forest Plan.

The comments regarding designating the area as an old-growth reserve are beyond the scope of the EIS/EIR and were referred to USFS staff. The lead agencies for this project have chosen Alternative 6 as their preferred alternative. This alternative does not include Segment A2, which passes through the Mt. Hoffman released roadless area. Thus, there would be no impact to this area if the lead agencies' preferred alternative is selected. If an alternative that contains Segment A2 is selected, it would not substantially alter the character of the Mt. Hoffman released roadless area.

Land Use and Recreation

The topic areas of comment on land use and recreation issues were:

- General
- Effects on the Overall Recreation Experience
- Effects on Dispersed Recreation
- Effects on Developed Recreation Use Areas
- Effects on Residential Areas

The majority of commentors expressed concern about the effects of the project on either the recreational experience in and near Medicine Lake or the experience of snowmobile users. Other commentors expressed concern about the potential effects of the project on hunting.

The responses clarify the potential effects of the project on the recreational experience in and near Medicine Lake and provide additional support for the conclusion that the project would not significantly affect uses in this area. The lead agencies for the project have selected Alternative 6 as their preferred alternative. This alternative does not include transmission line Segment A1; this segment would pass near Medicine Lake and would cross a developed trail. Since Alternative 6 would not use Segment A1, this alternative would avoid effects to recreation at Medicine Lake.

The responses also clarify the proposed project and how it would affect the use of snowmobiles in winter. Due to plowing, approximately seven miles of Forest Road 44N01 would be closed to snowmobile use as a result of this project. The effects of plowing on snowmobile use in the power plant and wellfield area are also discussed. A mitigation measure was modified to clarify how access would be maintained for snowmobiles within this area.

Mitigation Measure 4.15.8b was also clarified to state that "no shooting" signs would be posted in the power plant and wellfield area. This is the only area in which hunting would be partially restricted and would not represent a significant decline in hunting opportunities on the Klamath or Modoc National Forests.

Transportation

The topic areas of comment on transportation issues were:

- Vehicular Trips Generated by the Project
- Road Safety
- Effects on the Four Corners-Medicine Lake Snowmobile Park

Most commentors raised concerns about road safety in the project vicinity and parking issues for the Four Corners-Medicine Lake Snowmobile Park. Commentors were also concerned about the volume of traffic generated by the project.

The responses to transportation comments address the issue of road safety in the project area and explain that specific mitigation measures to ensure safety would be implemented if the project were approved. The responses also clarify that the Four Corners-Medicine Lake Snowmobile Park would not be used as a carpool area for the proposed project. The project-generated traffic volumes are also further explained.

Air Quality

The topic areas of comment on air quality issues were:

- Regulatory Issues
- Significance Thresholds
- Methodology
- Potential for Climatic Changes
- Air Quality Analysis
- Emissions
- Air Quality Impacts
- Odor Impacts
- Health Impacts
- Visibility Impacts
- Monitoring and Reporting
- Enforcement of Laws, Regulations, and Permit Conditions
- Mitigation Measures

The responses clarify the various impacts associated with dust, pollutants, noise and odors from the project. The responses also discuss the possibility for various forms of precipitation to be generated by the project. Further elaboration of the potential health impacts associated with the project is provided, the adequacy of the emissions calculations, modeling methodology, and proposed mitigation measures are supported. Project emission calculations have been refined, and minor changes have been made to the emission estimates provided in the Air Quality Section of the Draft EIS/EIR. No changes to the conclusions in this section have been made.

Noise

The primary areas of comment on noise issues were the following:

- General
- Methodology
- Significance Criteria
- Noise Sources During Construction
- Noise Impacts During Construction
- Noise Sources During Operation
- Noise Impacts During Operation

- Noise During Decommissioning
- Potential Vibration Impacts
- Alternatives
- Mitigation Measures

The responses to comments clarify the methodology used to evaluate potential noise impacts associated with the proposed project. The designation of sensitive receptor sites in the proposed project area was further explained and information was clarified regarding the locations of sensitive receptors in the Tionesta area.

Many commentors expressed objection to the use of the county noise standard associated with actively-used recreational areas (as opposed to passively used open spaces) when evaluating potential noise impacts. The responses explain that the area supports recreational uses that are considered active-uses, such as motor boats and snowmobiles. Thus, the county noise standard associated with active-use is the more appropriate county noise standard to use when evaluating noise impacts associated with the project. Furthermore, it was demonstrated that even if the county noise standard associated with passively used areas was applied to the proposed project, project noise levels would not exceed this standard.

The responses clarify the well drilling and operational noise analysis by explaining the methods used to obtain key noise levels and to determine project-related noise levels at sensitive receptor sites in the area. Minor revisions to the EIS/EIR were made to clarify definitions presented in the noise analysis.

Human Health and Safety

The main topics of comments on human health and safety issues were the following:

- Hazardous Materials
- Well Blowout Hazards
- Fire Hazards
- Electric and Magnetic Field Hazards
- Wellfield Facility Hazards
- Aircraft Hazards
- Threat of Disease
- Mitigation Measures

The primary areas commentors questioned were hazardous waste production and disposal, transport of hazardous materials, accidental release of hazardous materials, and hazards associated with the wellfield facility.

The responses explain that wastes associated with the proposed project would be treated in order to be classified as non-hazardous. However, if wastes deemed hazardous were produced by the project, disposal and transport of these materials would be consistent with all state and Federal regulations. The responses also clarify the procedures and safety plans that would be implemented to prevent accidental release of hazardous materials, and explain that emergency plans would be enacted if an accidental release were to occur.

Commentors expressed concern with the safety of the power plant and wellfield facility. The responses explain that the power plant would have restricted access and that the well pads would be constantly monitored. Furthermore, new roads into the wellfield would be gated and locked, preventing unauthorized access to the area.

Minor revisions to Mitigation Measure 4.11.4a were made to clarify the location of a cold water injection pipeline. In addition, the EIS/EIR was revised to reflect the change in cooling water treatment method from chlorine to sodium hypochlorite.

Socioeconomics

The main areas of comment on socioeconomics issues were:

- General
- Employment
- Short-Term Housing
- Effects on Minority and Low-Income Populations
- Property Values
- Effects on Tourism
- Public Services
- Solid Waste Disposal
- Public Finance

Several commentors expressed concerns regarding the proposed project's potential to reduce property values in the Medicine Lake and Tionesta areas. The responses provide information obtained from published studies regarding the effects of transmission lines on property values in rural areas. This information supports the findings in the EIS/EIR. Minor revisions to the EIS/EIR were made to clarify that the proposed project would have a less-than-significant effect on property values in the Medicine Lake area.

Commentors also expressed concern regarding the need for additional police services to patrol residential areas in the Medicine Lake area as a result of the proposed project. The responses clarify that there would be ample police services during the summer months when construction occurred, and that there would be no additional roads maintained or built which could provide access to these areas during the winter months.

Cumulative Effects

The topic areas of comment on cumulative effects issues were:

- Cumulative Projects
- Cumulative Effects

The responses clarify why the Fourmile Hill and Telephone Flat projects are the only reasonably foreseeable geothermal development at the Glass Mountain KGRA at this time. The responses also expand upon the discussion of potential cumulative effects from the Telephone Flat project that was provided in the Draft EIS/EIR. Subsequent to release of the Fourmile Hill Draft EIS/EIR, specific details on the size, surface disturbance, and potential environmental effects of the proposed Telephone Flat project

were made available through the Telephone Flat Draft EIS/EIR (released for public review in May 1998). The description in the Draft EIS/EIR of the Telephone Flat project was revised to provide these details, as well as clarify the role of the previously approved Glass Mountain exploration wells. The possible cumulative effects of the cumulative projects on various individual environmental parameters have been further explained, and these effects have been revised to incorporate quantitative information from the Telephone Flat Draft EIS/EIR.

Other Statutory Sections

The topic areas of comment on other statutory section issues were:

- Growth-Inducing Impacts
- Short-Term Use Versus Long-Term Productivity
- Significant Irreversible Environmental Changes

The responses further support the conclusions proved in the Draft EIS/EIR regarding the possibility of additional growth in the area occurring due to development of the project. The responses also discuss the analysis of short-term and long-term impacts that might be caused by the project, as well as the possibility of significant irreversible environmental changes occurring if the project is developed as proposed.

Mitigation Monitoring and Reporting Program

Comments on Mitigation Monitoring and Reporting Program (MMRP) issues were discussed under one heading entitled "Comments and Responses." There were only three commentors on the MMRP. The comments on the MMRP requested that:

- The type and amount of mitigation be clarified
- The specialists chosen for the project be selected by the USFS
- The mitigation measures be enforced

The responses clarified the type of mitigation to be used, the selection process for the specialists to be used on the project, and the enforcement protocol for the proposed mitigation measures. The MMRP has been revised to clarify that the mitigation measures apply to Alternatives 1 through 6, except as noted.

NEPA/CEQA Issues

The topic areas of comment on NEPA/CEQA issues were:

- NEPA/CEQA Adequacy
- EIS/EIR Approach
- Draft EIS/EIR Public Involvement
- Plan to Act Against Project Approval

The responses clarify the document's adequacy under the provisions of NEPA and CEQA. In addition, the responses address the general adequacy of the document as an informational tool, as well as the adequacy of the mitigation measures proposed. Finally, the responses articulate the roles of the lead agencies in ensuring NEPA and CEQA compliance.

Project Preference

The topic areas of comment on project preference were:

- Alternative Preference
- Project Opposition
- Project Support

The commentors generally expressed opinions either supporting or opposing construction of the proposed project. The responses provided commentary where appropriate, but primarily served to acknowledge the commentors' viewpoints, and reference these viewpoints to the responsible decision-making agencies.

General

The topic areas of comment on general issues were:

- Public Requests
- General Concern About Project Effects
- Incorporation of Other Comments by Reference
- Statements and Opinions
- Other General Comments

The responses provided information, clarifications, and further explanation in response to these comments where appropriate. Opinions and statements made in the comments were noted, and referred to the responsible decision-making agencies for their consideration.

American Indian Consultation

Various regulations require that local American Indian groups be consulted regarding proposed projects. Consultations with local American Indian groups are currently being conducted regarding the proposed action.

Three meetings were conducted between October 1995 and April 1996 with American Indian tribal representatives from the Klamath Tribes and the Shasta group at Butte Valley and with a Pit River Tribal representative. A presentation was also made to Pit River Tribal Council members regarding the proposed action in April 1996. Subsequently, three meetings were held in June and July, 1996 with the Klamath Tribes Cultural Heritage Committee and with members of the Ajumawi and Atwamsini Bands of the Pit River Tribe. A site visit for tribal members was held in September 1996 and additional meetings were held in June 1997. Five additional meetings with the Pit River and Klamath Tribes were held from August 1997 through April 1998.

An ethnographic study was conducted as part of this EIS/EIR to identify traditional cultural values and uses in the project region, and to identify tribal concerns about the proposed project. The study included literature review, interviews with tribal members, and field verification of traditional use sites identified by tribal members. Issues raised by local tribal members in interviews indicate that local tribes have concerns that the geothermal operations would impact traditional uses in the Medicine Lake Highlands and cultural resource sites along the transmission line. Concerns were also raised that

the visual and noise effects of the project would alter the natural tranquillity and beauty of the sacred area. Effects on wildlife and water quality were also of concern.

Overview of the Proposed Action

PROJECT LOCATION

The power plant and wellfield area would be located approximately three miles northwest of Medicine Lake, California on Federal Geothermal Leases CA21924 and CA21926. These geothermal leases are located within the boundaries of the Glass Mountain Federal Geothermal Unit (14-08-0001-18160), but the leases are not committed to the Unit or subject to Unit requirements (BLM 1982). The power plant and wellfield area would be located in Sections 21, 28, and 29, Township 44 North, Range 3 East, Mount Diablo Base and Meridian (MDB&M), Siskiyou County. The power plant and wellfield are shown on Figure S-3.

The proposed transmission line would extend east from the power plant site through the Modoc National Forest to a proposed intertie substation along the BPA Malin-Warner transmission line (which parallels Highway 139). The proposed substation would be located on the Modoc National Forest near Perez, California, in Section 12, Township 3 North, Range 6 East, MDB&M, Modoc County.

PROPOSED ACTION

Wellfield and Power Plant

The proposed project would involve production of geothermal fluids (hot water and steam) from an underground geothermal reservoir. The fluids would flow under pressure up and out of the initial 9 to 11 two-phase production wells that would be drilled at the five proposed production well pad sites. The fluids would be transported via surface pipelines from the wells to the proposed dual-flash geothermal power plant, where the steam would be directed to two steam turbine-driven generators. The turbine exhaust steam would be condensed and pumped into a cooling tower. Spent brine and condensate would be pumped through surface pipelines to the three proposed injection wells for injection to the subsurface geothermal reservoir. There would initially be one injection well located at each of the injection well pads.

In order to provide access to the well pad sites and power plant, roads would be constructed and/or improved in the wellfield and power plant area. In addition, a temporary hand-laid water pipeline would be installed from the Arnica Sink area to the wellfield to provide water for well drilling activities during the first construction season.

Transmission Line

Electricity generated by the power plant would be transmitted to the existing BPA Malin-Warner transmission line via the proposed 24-mile, 230-kV transmission line. The proposed transmission line would extend from the Fourmile Hill power plant site to a proposed intertie substation along the BPA Malin-Warner transmission line. The proposed transmission line is comprised of segments A1, A2, B1, and C1. This line would be constructed using H-frame wood poles with steel structures used for strength

at certain locations (such as angle points and long spans). Right-of-way width would be approximately 125 feet along the constructed length of the transmission line; however, vegetation clearance would not be required for the entire right-of-way. Access roads for installation of structures and maintenance activities would be constructed along portions of the right-of-way.

PROJECT LIFESPAN AND DECOMMISSIONING

Construction of the proposed project would take approximately 3 years, and the planned period of commercial operation is 45 years. At the end of the project lifespan, the project would be decommissioned. All structures and equipment at the power plant site and well pads would be dismantled and removed, and all disturbed areas would be restored to pre-project conditions as practicable and/or to conditions acceptable to the USFS and BLM. Geothermal wells would be plugged and abandoned. The liquid-holding sump at each well pad would be emptied of residual fluid, backfilled with native soil to approximate pre-project contours, and scarified to promote revegetation. The transmission line and substation would also be dismantled and removed.

At the present time, no extension of the lifespan of the project beyond that currently proposed is contemplated or envisioned. If a decision is made at a later date to extend the project lifespan, authorization of this extension may be subject to additional environmental review and documentation.

Alternatives to the Proposed Action

A range of alternatives has been developed for detailed analysis in the EIS/EIR. These alternatives are feasible, meet the purpose and need for the project, and respond to key environmental issues. Five alternative transmission line routes are considered in detail in the EIS/EIR. In addition to these alternatives, the EIS/EIR evaluates the "No Action" alternative, which is required by both NEPA and CEQA. Table S-2 identifies the various transmission line segments that would be used by the proposed project or alternatives, and Table S-3 identifies which route segments are included in each alternative. Figure S-2 shows the proposed and alternative transmission line routes.

ALTERNATIVES COMPARISON

Table S-4 provides a comparative analysis of the potential effects (after mitigation) for key issues for all seven of the project alternatives, including the proposed action. Key issues are those issues that were identified as being of significant concern during the public scoping process for the project (see Section 1.6). Table S-4 identifies the potential effects of the proposed action, and compares the level of impact of each alternative to the proposed action. For many of the alternatives, the effects would be the same or similar to those of the proposed project.

In Table S-4 (as well as throughout this EIS/EIR), a distinction is made between "effects," "adverse effects," and "significant adverse effects." Effects are changes in the environment that would occur as a result of the project but that would not be adverse and would not be significant under CEQA. Adverse effects are effects that would occur as a result of the project, but that would be less than significant under CEQA.

Table S-2: Transmission Line Route Segments

Segment Number	Segment Location	Length (Miles)
Proposed Action		
A1	Extends southeast from power plant approximately 2 miles towards Medicine Lake, then east for approximately 3 miles to point south of Mt. Hoffman and east of Arnica Sink.	4.72
A2	A2 extends northeast between Mt. Hoffman and Glass Mountain to the "matchpoint."	3.67
B1	From the matchpoint, B1 extends east approximately 6 miles then turns to the northeast for approximately 1 mile.	6.78
C1	From the eastern ends of B1 and B2, C1 extends northeast, turning due east for 6 miles to a connection with the BPA Malin-Warner transmission line.	8.27
Alternatives		
A3	A3 extends north from the power plant, passing west of Fourmile Hill, then turning southeast. From eastern side of Fourmile Hill, it extends approximately 5 miles southeast to the "matchpoint."	8.17
B2	B2 extends southeast from the eastern end of A1. It then turns east passing to the south of Glass Mountain and Lyons Peak and then to the northeast along the former California-Oregon Transmission Project corridor.	12.74
C2	C2 continues northeast along the former California-Oregon Transmission Project corridor, then turns east and then northeast, following the alignment of road 44N32 and passing north of the Dry Lake Area.	9.66

SOURCE: G.E. Raleigh and Associates, Inc. and MHA Environmental Consulting, Inc. 1997

Table S-3: Alternatives and Corresponding Transmission Line Route Segments

Alternative	Segments [1]	Length (miles)
Proposed Action (Alternative 1)	A1, A2, B1, C1	23.4
Alternative 2	A1, A2, B1, C2	24.8
Alternative 3	A1, B2, C1	25.7
Alternative 4	A1, B2, C2	27.1
Alternative 5	A3, B1, C1	23.2
Alternative 6	A3, B1, C2	24.6
Alternative 7	No Action	0.0

1 These segment designations correspond with the route segment designators shown on Figure 2.3-1.

SOURCE: G.E. Raleigh and Associates, Inc. and MHA Environmental Consulting, Inc. 1997

Table S-4: Comparison of Key Issues for Alternatives[1]

Environmental Effect[2]	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Hydrology							
Effects to Medicine Lake water quality	A	A	A	A	A	A	N
Effects to Medicine Lake water quantity	N	N	N	N	N	N	N
Effects to regional water quality or quantity	N	N	N	N	N	N	N
Geothermal Resources							
Effects on regional thermal features	N	N	N	N	N	N	N
Cultural Resources							
Effects to historic or archaeological resources	E	E	E+	E	E+	E	N
Traditional Cultural Values							
Surface effects on traditional cultural sites	N	N	N	N	N	N	N
Effects on access to traditional sites	N	N	N	N	N	N	N
Effects on traditional cultural values	S	S+	S	S+	S-	S+	N
Effects on traditional cultural uses	S	S+	S	S-	S-	S-	N
Vegetation							
Effects of vegetation removal	A	A+	A+	A+	A-	A-	N
Effects to special status plant species	A	A	A	A	A	A	N
Effects to old growth forest (late seral areas)	A	A	A+	A+	A	A	N
Wildlife							
Effects to general wildlife habitat	A	A+	A+	A+	A-	A-	N
Effects to special-status species (northern spotted owl, northern goshawk, bats)	A	A	A+	A+	A-	A-	N

Table S-4: Comparison of Key Issues for Alternatives, continued

Environmental Effect[2]	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Visual Resources							
Effects of transmission line crossings of visually-sensitive roads	A	A	A+	A+	A-	A-	N
Effect on views from Medicine Lake	S	S	S	S	A	A	N
Effect on views from Tionesta and vicinity	A	A-	A-	A-	A	A-	N
Effect on views from Lava Beds National Monument	A	A	A	A	A	A	N
Plans and Policies							
Disturbance of roadless release areas	A	A	N	A	N	A	N
Land Use and Recreation							
Effects on Medicine Lake recreation and residences	A	A	A	A	N	N	N
Effects on snowmobiling	A	A	A	A	A	A	N
Air Quality							
Construction dust (PM_{10}) effects at Medicine Lake	A	A	A	A	A-	A-	N
Construction dust (PM_{10}) effects at Tionesta	A	N	A	N	A	N	N
Power plant emissions	A	A	A	A	A	A	N
Noise							
Construction and operation noise effects at Medicine Lake	S	S	S	S	A	A	N
Construction noise effects at Tionesta	S	N	S	N	S	N	N

Notes:

[1] This table focuses on the effects of key issues, as identified through the scoping process for the project.

[2] N = No effect
E = Effect
A = Adverse effect
A- = Adverse effect less than the proposed action
A+ = Adverse effect greater than the proposed action
S = Significant adverse effect
S- = Significant adverse effect less than the proposed action
S+ = Significant adverse effect greater than the proposed action

SOURCE: MHA Environmental Consulting, Inc. 1997

Significant adverse effects are effects of the project that would be significant under CEQA. In comparing alternatives to the proposed action, a "+" sign is used in Table S-4 for those effects that would be greater than the proposed action, and a"-" sign is used for effects that would be less than the proposed action.

LEAD AGENCIES' PREFERRED ALTERNATIVE

At the issuance of the Draft EIS/EIR, the lead agencies had not identified a preferred alternative. NEPA requires that the lead agencies identify a preferred alternative (40 CFR 1502.14(e)). Based on the evaluation contained in the Draft EIS/EIR and public and agency comment on the Draft EIS/EIR, the lead agencies have identified Alternative 6 as their preferred alternative. This alternative would use transmission line segment A3 instead of segments A1 and A2 proposed as part of the proposed action, and segment C2 instead of segment C1 (see Figure S-1). Segment A3 would be routed north from the proposed power plant to avoid the Medicine Lake area, and segment C2 would be located in the vicinity of Dry Lake to avoid passing near Tionesta and Timber Mountain.

ENVIRONMENTALLY PREFERABLE ALTERNATIVE

Of the alternatives under consideration in this document, implementation of the No Action alternative would result in the avoidance of the environmental effects that would occur under the proposed project and the other alternatives. The No Action alternative would therefore be considered the environmentally preferable alternative; however, the No Action alternative would not meet the purpose and need for the proposed action.

Pursuant to CEQA Guidelines Section 15126(d)(4), an environmentally superior alternative must also be identified from among other project alternatives in the EIS/EIR. Based on the analysis contained in Chapter 4 of this document and summarized in Tables S-4 and S-5, Alternative 6 would be considered the environmentally superior alternative from among the project alternatives, other than the No Action alternative. Alternative 6 would have the least overall effect on the environment of these alternatives, because it would:

- Avoid construction of the transmission line near Medicine Lake and the associated visual, recreation, noise, and air quality effects at this location
- Minimize effects to traditional cultural values and uses (specifically, to avoid effects near Medicine Lake and Timber Mountain)
- Minimize vegetation disturbance, including tree disturbance, late seral forest removal, and potential effects to habitat for sensitive plant species
- Minimize effects to wildlife habitat, including sensitive species such as northern spotted owl, northern goshawk, and bats
- Avoid transmission line construction next to the community of Tionesta

Affected Environment

The proposed wellfield and power plant would be located within the Medicine Lake Highlands and the proposed and alternative transmission lines would extend from the power plant over or around the Highlands and down onto the Modoc Plateau. The Medicine Lake Highlands is an area that is characterized by volcanic activity. Past volcanic activity has resulted in a variety of features that make up the geologic and topographic characteristics of the Medicine Lake Highlands. The volcanoes within the Highlands include small cinder cones (such as Fourmile Hill) and lava domes and glass flows (such as Glass Mountain), and relatively low, gently sloping shield volcanoes (such as Medicine Lake volcano).

The presence of geothermal resources in this area is due to this volcanic activity. The geothermal system in the immediate area consists of fluids that are heated at depth by a magmatic heat source underlying the Medicine Lake caldera. The heated fluids then rise upwards through fractures. There are two distinct groundwater systems, the geothermal system, and a shallow, cold groundwater aquifer. The shallow groundwater is the source of the water for the water supply wells in the area and is confined by a relatively impermeable layer of clay-rich ash flow tuffs which underlie the lavas. This tuff isolates the shallow groundwater system from the geothermal system.

Medicine Lake, which is located about 3 miles southeast of the power plant site, is the largest surface water body within 10 miles of the project area. The lake lies in the Medicine Lake caldera at approximately 6,700 feet in elevation. Other nearby lakes and springs include Little Medicine Lake, Bullseye Lake, Blanche Lake, Schonchin Spring, Crystal Springs, and Paynes Springs. Paynes Creek is the only perennial stream within five miles of the wellfield and power plant site.

The vegetation in the Medicine Lake Highlands is characterized primarily by a mosaic of upper mountain conifer forest types, including stands of red fir and lodgepole pine, especially in the western portions of the study area. The eastern portion of the project area is on the Modoc Plateau, and vegetation consists of scrub-dominated vegetation types with sparse ponderosa pine and woodlands of western juniper. Wildlife habitat characteristics of the project area are based on these vegetation characteristics. The visual characteristics of the area are also defined by the presence of the Medicine Lake Highlands. The Highlands are an uplifted area on the Modoc Plateau that can be seen from miles away, especially from the east and north.

The project area has been traditionally used by several local tribes, including the Klamath, Pit River, and Shasta Tribes. The Medicine Lake Highlands and the Modoc Plateau are important to tribal members for traditional and spiritual uses. Many of the topographic features formed by volcanic action in the Medicine Lake Highlands are known to hold spiritual significance for past and present-day tribal peoples. Springs and caves are also important features. Many traditional use areas are located throughout the Highlands and the Modoc Plateau, and are known localities for hunting and gathering, mineral resources, social interaction, and medicinal/spiritual purposes, both historically and by present-day tribal peoples. This historical use is supported by existing archaeological evidence from the project vicinity which suggests that humans have been active in the area for approximately the last 10,000 years.

The primary land uses in the Medicine Lake Highlands are recreation, timber, and limited mining. Recreation uses dominate in the Medicine Lake area with the presence of campgrounds and seasonal residences. Dispersed recreation activities occur throughout the National Forests and consist of hiking, hunting, off-road vehicle use, and snow-mobiling and cross-country skiing during the winter. The area is accessed by Primary Forest Route 49, which provides north/south access, and Primary Forest Routes 97 and 77, which provide east/west access. Land uses on the Modoc Plateau consist primarily of grazing activities (sheep and cattle) and residential uses in the community of Tionesta.

The climate in the project area is characterized by warm, dry summers and cool, moist winters. As most of the Medicine Lake Highlands lie at elevations higher than 4,000 feet, the majority of winter precipitation falls as snow. Air quality is generally good in the region, although the air basin is classified by the California Air Resource Board as nonattainment for PM_{10} (particulate matter less than 10 microns). Ambient noise levels are low and typical of rural undeveloped areas. The highest noise levels are likely within the Medicine Lake area during the summer season when boating activities are at their peak.

Population in the project area is low and includes the community of Tionesta and scattered residences. Other local communities in the vicinity of the project include Alturas, Dorris, Dunsmuir, Etna, Fort Jones, Montague, Mount Shasta, Tulelake, Weed, and Yreka. The majority of local housing and some jobs occur in these communities. Employment in the region relates to timber, agriculture, recreation, mining, trade and service, and, more recently, development and construction.

Environmental Consequences

EFFECTS OF THE PROPOSED ACTION AND MITIGATION MEASURES

Table S-5 at the end of this section provides a summary of the environmental consequences and levels of significance of the effects for the proposed action and all alternatives. This table includes all of the impacts for the proposed action identified in Chapter 4 of the EIS/EIR. The level of significance of each impact prior to mitigation is identified. The table identifies whether mitigation is recommended and the level of significance after mitigation. No mitigation would be required for Alternative 7, the No Action alternative. The Draft EIR/EIS identifies mitigation for project effects under each environmental parameter.

CUMULATIVE EFFECTS

The cumulative effects of the proposed action and the cumulative effects of each of the alternatives are addressed in Chapter 4. The project could result in significant cumulative effects through the potential for conflicts with religious use of the area by local tribal members. The temporary noise and air quality effects from project construction could be cumulatively significant if they overlapped with other projects, such as the proposed CalEnergy Telephone Flat geothermal project. Cumulative effects in the Medicine Lake area would be avoided by alternatives.

UNAVOIDABLE ADVERSE EFFECTS

The unavoidable adverse effects of the project are described in Chapter 4. Unavoidable significant adverse impacts (long-term and after mitigation) would result from the potential for conflicts with traditional cultural values and American Indian concerns, and visual effects of the proposed project. The visual effects would be avoided by alternatives.

OTHER EFFECTS

As required by NEPA and CEQA, Chapter 4 also addresses potential growth-induced effects, the short-term use compared with long-term productivity, cumulative and long-term adverse environmental effects, and significant irreversible environmental changes.

Table S-5: Summary of Environmental Consequences and Mitigation Measures for the Proposed Project

IMPACT	LEVEL OF SIGNIFICANCE BEFORE MITIGATION							MITIGATION RECOMMENDED?							LEVEL OF SIGNIFICANCE AFTER MITIGATION						
ALTERNATIVES	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
4.2 GEOLOGY AND SOILS																					
4.2.1 Effects on Topography	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.2.2 Effects on Unique Geologic Features and Paleontological Resources	N	N	N	N	N	N	N	Yes	Yes	Yes	Yes	Yes	Yes	No	N	N	N	N	N	N	N
4.2.3 Mineral Resources	N	N	N	N	N	N	N	No	No	No	No	No	No	No	N	N	N	N	N	N	N
4.2.4 Ground Subsidence	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.2.5 Seismic Activity	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.2.6 Volcanic Activity	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.2.7 Liquefaction	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.2.8 Slope Instability	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.2.9 Snow Avalanches	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.2.10 Effects on Soil Erosion	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.2.11 Effects of Deposition of Air Emissions	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.3 HYDROLOGY																					
4.3.1 Effect of Water Use	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.3.2 Effects of Geothermal Fluid Production and Injection on Water Quantity	N	N	N	N	N	N	N	Yes	Yes	Yes	Yes	Yes	Yes	No	N	N	N	N	N	N	N
4.3.3 Effects of Increased Surface Runoff	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.3.4 Effects of Flooding	N	N	N	N	N	N	N	No	No	No	No	No	No	No	N	N	N	N	N	N	N
4.3.5 Effects on Stream Channels	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.3.6 Effects of Geothermal Drilling, Production, and Injection on Water Quality	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.3.7 Effects of Air Emissions on Water Quality	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.3.8 Effects of Sanitary Waste on Water Quality	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N

S = Significant L = Less than Significant N = No Effect

Table S-5: Summary of Environmental Consequences and Mitigation Measures for the Proposed Project

IMPACT	LEVEL OF SIGNIFICANCE BEFORE MITIGATION							MITIGATION RECOMMENDED?							LEVEL OF SIGNIFICANCE AFTER MITIGATION						
ALTERNATIVES	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
4.3.9 Effects of Chemical and Hazardous Material Spills on Water Quality	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.4 GEOTHERMAL RESOURCES																					
4.4.1 Effects on the Life Expectancy of the Geothermal Reservoir	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.4.2 Effects of Injection on Reservoir Characteristics	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.4.3 Effects on Regional Thermal Features	N	N	N	N	N	N	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.5 CULTURAL RESOURCES																					
4.5.1 Effects on Cultural Resources From Surface Disturbance	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.6 TRADITIONAL CULTURAL VALUES																					
4.6.1 Effects on Medicine Lake Highlands	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	S	S	S	S	S	S	N
4.6.2 Direct Effects on Traditional Sites in the Medicine Lake Highlands	S	S	S	S	N	N	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.6.3 Effects of Project Noise on Traditional Sites and Uses	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	S	S	S	S	S	S	N
4.6.4 Effects on Access to Traditional Sites	L	L	L	L	N	N	N	Yes	Yes	Yes	Yes	No	No	No	N	N	N	N	N	N	N
4.6.5 Effects on Traditional Religious Practices	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	S	S	S	S	S	S	N
4.6.6 Effects on Landscape Views	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	S	S	S	S	S	S	N
4.6.7 Effects on Natural and Other Resources in the Project Region:																					
• Archeaologic and Historic	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
• Water Quality	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
• Vegetation	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
• Wildlife	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
• Human Health and Safety	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N

S = Significant L = Less than Significant N = No Effect

Table S-5: Summary of Environmental Consequences and Mitigation Measures for the Proposed Project

IMPACT	LEVEL OF SIGNIFICANCE BEFORE MITIGATION							MITIGATION RECOMMENDED?							LEVEL OF SIGNIFICANCE AFTER MITIGATION						
ALTERNATIVES	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
• Socioeconomics	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	S	S	S	S	S	S	N
4.7 VEGETATION																					
4.7.1 Effects on General Vegetation	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.7.2 Depositional Effects on Vegetation	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.7.3 Effects on Special-Status Plant Species	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.7.4 Effects on Sensitive Plant Communities	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.7.5 Introduction of Weeds	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.8 WILDLIFE																					
4.8.1 Potential for General Wildlife Habitat Loss	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.8.2 Wildlife Effects from Noise and Disturbance	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.8.3 Effects on Special-Status Species	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.8.4 Bird Electrocution and Collision Hazards	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.9 VISUAL RESOURCES																					
4.9.1 Temporary Visual Effects of Vehicles and Equipment	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.9.2 Effects on Wellfield and Power Plant Vicinity Views	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.9.3 Effect on Primary Forest Route 49 Views Near the Plant Site	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.9.4 Effects on Views from Medicine Lake Area Roads	S	S	S	S	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.9.5 Effects on Medicine Lake Views	S	S	S	S	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	S	S	S	S	L	L	N
4.9.6 Effect on Little Mount Hoffman Views	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N

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Table S-5: Summary of Environmental Consequences and Mitigation Measures for the Proposed Project

IMPACT	LEVEL OF SIGNIFICANCE BEFORE MITIGATION							MITIGATION RECOMMENDED?							LEVEL OF SIGNIFICANCE AFTER MITIGATION						
ALTERNATIVES	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
4.9.7 Effect on Arnica Sink and Glass Mountain Views	S	S	S	S	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.9.8 Effects on Tionesta and Vicinity Views	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.9.9 Effects on Lava Beds National Monument Views	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.10 PLANS AND POLICIES																					
4.10.1 Consistency with Klamath National Forest Land and Resource Management Plan	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L*	L*	L*	L*	L*	L*	N
4.10.2 Consistency with Modoc National Forest Land and Resource Management Plan	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.10.3 Consistency with Lease Stipulations	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.10.4 Consistency with Siskiyou County General Plan	N	N	N	N	N	N	N	No	No	No	No	No	No	No	N	N	N	N	N	N	N
4.10.5 Consistency with Modoc County General Plan	N	N	N	N	N	N	N	No	No	No	No	No	No	No	N	N	N	N	N	N	N
4.11 LAND USE AND RECREATION																					
4.11.1 Effect on the Overall Recreation Experience	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.11.2 Effect on Developed Recreation Use Areas	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.11.3 Effects on Medicine Lake Residences	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.11.4 Effect on Dispersed Recreation	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.11.5 Consistency with ROS Allocations	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N

* If Klamath National Forest LRMP is amended

S = Significant L = Less than Significant N = No Effect

Table S-5: Summary of Environmental Consequences and Mitigation Measures for the Proposed Project

IMPACT	LEVEL OF SIGNIFICANCE BEFORE MITIGATION							MITIGATION RECOMMENDED?							LEVEL OF SIGNIFICANCE AFTER MITIGATION						
ALTERNATIVES	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
4.11.6 Effect on Recreation at the Lava Beds National Monument	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.11.7 Effects on Tionesta Residences	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.11.8 Effects on Range Lands	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.11.9 Effects on Timber Lands	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.11.10 Effect on Mining and Geothermal Exploration Activities	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.11.1 Effect on Mushroom Harvesting	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.12 TRANSPORTATION																					
4.12.1 Effects on Road Traffic	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.12.2 Effect on Structural Integrity of Project Area Roads	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.12.3 Summer Access Issues	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.12.4 Winter Access Issues	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.13 AIR QUALITY																					
4.13.1 Effects of Construction PM_{10} Emissions	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	S	S	S	S	S	S	N
4.13.2 Effects of Construction H_2S Emissions	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.13.3 Effects of Construction Emissions of Other Criteria Pollutants	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.13.4 Effects of Operation PM_{10} Emissions	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.13.5 Effects of Operation H_2S Emissions	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.13.6 Effects of Operation Emissions Other Criteria Pollutants	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.13.7 Effect of Decommissioning PM_{10} Emissions	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.13.8 Effect on Public Health	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.13.9 Effect on Visibility	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	S	S	S	S	S	S	N

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IMPACT	LEVEL OF SIGNIFICANCE BEFORE MITIGATION							MITIGATION RECOMMENDED?							LEVEL OF SIGNIFICANCE AFTER MITIGATION						
ALTERNATIVES	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
4.13.10 Effect on Global Warming	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.13.11 Conformity Analysis	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.14 NOISE																					
4.14.1 Effects on Forest Noise Levels	S	S	S	S	S	S	N	No	No	No	No	No	No	No	S	S	S	S	S	S	N
4.14.2 Noise Effects on Sensitive Receptors Near Medicine Lake	S	S	S	S	N	N	N	Yes	Yes	Yes	Yes	No	No	No	S	S	S	S	N	N	N
4.14.3 Noise Effects on Sensitive Receptors Near Tionesta	S	L	S	L	S	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	S	L	S	L	S	L	N
4.15 HUMAN HEALTH AND SAFETY																					
4.15.1 Storage, Use, Transport, and Disposal of Hazardous Materials	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.15.2 Accidental Releases of Hazardous Materials	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.15.3 Well Blowout Hazards	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.15.4 Geothermal Fluid Hazards	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.15.5 Fire Hazards	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.15.6 Electric and Magnetic Fields	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.15.7 Downed Power Lines	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.15.8 Health Risk from Presence of Project Facilities	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.16 SOCIOECONOMICS																					
4.16.1 Effects on Population	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.16.2 Effects on Employment	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.16.3 Effect on Housing and Lodging	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.16.4 Effect on Minority and Low-Income Populations	S	S	S	S	S	S	N	Yes	Yes	Yes	Yes	Yes	Yes	No	S	S	S	S	S	S	N
4.16.5 Effect on Local Property Values	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.16.6 Effect on Schools	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N

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Table S-5: Summary of Environmental Consequences and Mitigation Measures for the Proposed Project

IMPACT	LEVEL OF SIGNIFICANCE BEFORE MITIGATION							MITIGATION RECOMMENDED?							LEVEL OF SIGNIFICANCE AFTER MITIGATION						
ALTERNATIVES	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
4.16.7 Effect on Police, Fire Protection, and Emergency Services	L	L	L	L	L	L	N	Yes	Yes	Yes	Yes	Yes	Yes	No	L	L	L	L	L	L	N
4.16.8 Effect on Water and Sanitary Sewer Services	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.16.9 Effect on Solid Waste Disposal	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.16.10 Effect on Utility Systems	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N
4.16.11 Effect on Public Finance	L	L	L	L	L	L	N	No	No	No	No	No	No	No	L	L	L	L	L	L	N

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1: INTRODUCTION AND PURPOSE AND NEED

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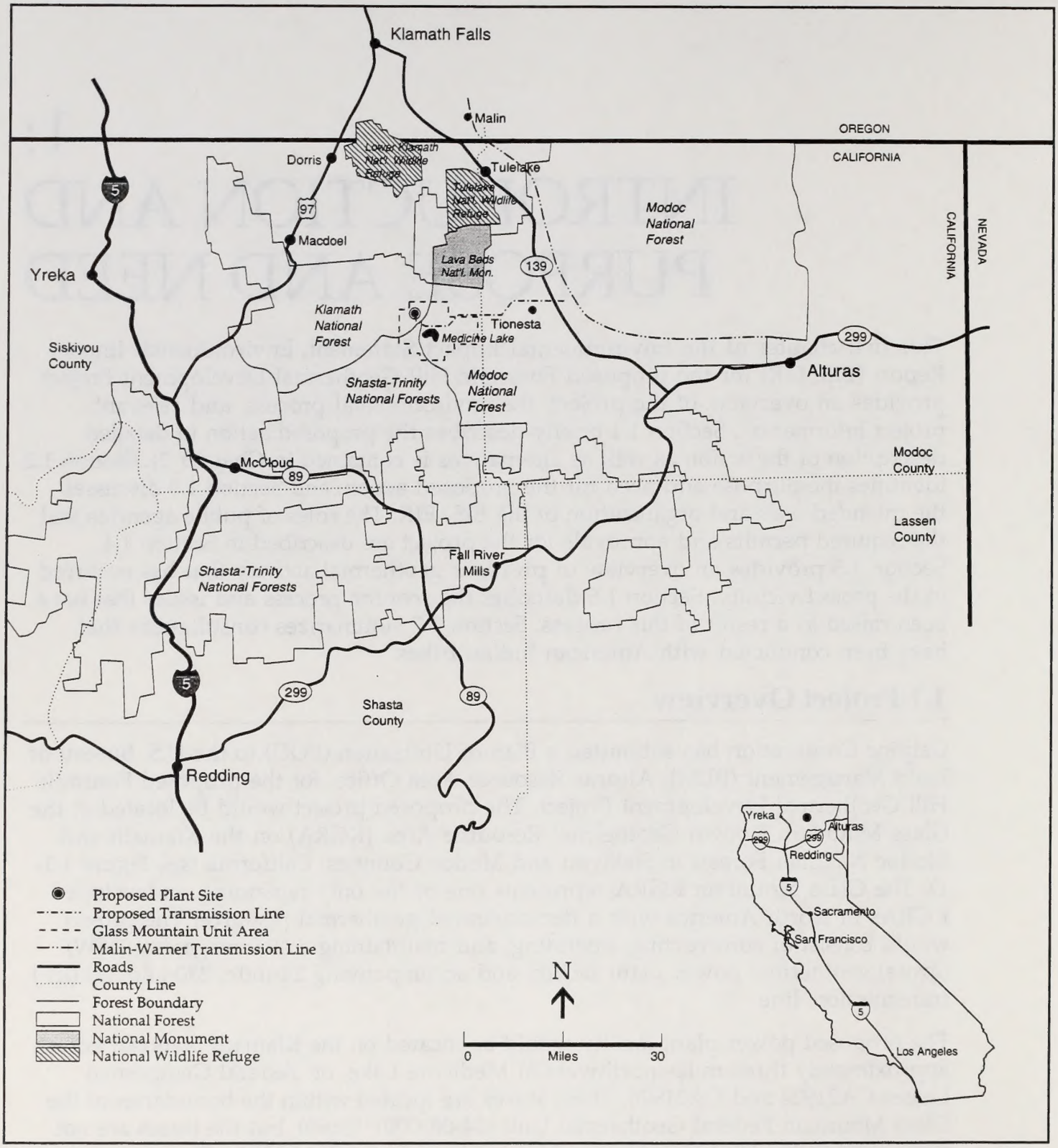
This first chapter of the Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the proposed Fourmile Hill Geothermal Development Project provides an overview of the project, the environmental process, and relevant project information. Section 1.1 briefly describes the proposed action (a detailed description of the action as well as alternatives is contained in Chapter 2). Section 1.2 identifies the purpose and need for the proposed action, and Section 1.3 discusses the intended uses and organization of the EIS/EIR. The roles of public agencies and the required permits and approvals for the project are described in Section 1.4. Section 1.5 provides an overview of previous geothermal activity that has occurred in the project vicinity. Section 1.6 describes the scoping process and issues that have been raised as a result of this process. Section 1.7 summarizes consultations that have been conducted with American Indian tribes.

1.1 Project Overview

Calpine Corporation has submitted a Plan of Utilization (POU) to the U.S. Bureau of Land Management (BLM), Alturas Resource Area Office, for the proposed Fourmile Hill Geothermal Development Project. The proposed project would be located at the Glass Mountain Known Geothermal Resource Area (KGRA) on the Klamath and Modoc National Forests in Siskiyou and Modoc Counties, California (see Figure 1.1-1). The Glass Mountain KGRA represents one of the only remaining undeveloped KGRAs in North America with a demonstrated geothermal resource. The project would consist of constructing, operating, and maintaining a 49.9 megawatt (MW) (gross) geothermal power plant facility and accompanying 24-mile, 230-kilovolt (kV) transmission line.

The proposed power plant facility would be located on the Klamath National Forest, approximately three miles northwest of Medicine Lake, on Federal Geothermal Leases CA21924 and CA21926. These leases are located within the boundaries of the Glass Mountain Federal Geothermal Unit (14-08-0001-18160), but the leases are not committed to the Unit or subject to Unit requirements (BLM 1982). The power plant facility would include the power plant, geothermal production and injection wells, well pads, roads, and interconnected geothermal fluid pipelines.

Figure 1.1-1: Regional Location Map



The proposed transmission line would extend in an easterly direction from the proposed power plant site through the Modoc National Forest to a proposed substation along the Bonneville Power Administration (BPA) Malin-Warner transmission line (which parallels Highway 139) near Perez, California. The transmission line would be constructed using H-frame wood poles with steel structures at certain locations, and access roads would be constructed at various locations along the transmission line route for line installation and maintenance purposes.

1.2 Purpose and Need for Proposed Action

The purpose of the Fourmile Hill Geothermal Project is to develop the geothermal resource on Calpine's Federal Geothermal Leases CA21924 and CA21926 to economically produce and deliver electrical energy to BPA and others. The need for the project was stated by the U.S. Geothermal Steam Act of 1970, the Geothermal Energy, Research, Development, and Demonstration Act of 1974, the Federal Land Policy and Management Act (FLPMA) of 1976, and the Energy Policy Act of 1992. The proposed project is consistent with these acts which direct the Federal government to foster and encourage private enterprise in the development of alternative energy resources, within appropriate environmental constraints.

Pursuant to the Geothermal Steam Act of 1970 (30 U.S.C. 1001-1025), Calpine's Federal geothermal leases grant the right to develop and utilize the geothermal steam and associated geothermal resources (30 U.S.C. 1003). The standard stipulations for Federal geothermal leases issued under the Geothermal Steam Act of 1970 convey the "exclusive right and privilege to drill for, extract, produce, remove, utilize, sell, and dispose of geothermal steam and associated geothermal resources...in or under" the leased lands. Environmental analyses were conducted prior to issuing these Federal geothermal leases.

The Northwest Power Act (U.S. Congress Northwest Power Planning and Conservation Act of 1980, P.L. 96-501) encourages the development of renewable resources within the Pacific Northwest, and authorizes BPA to acquire resources that have potential for providing cost-effective service to the region. In February 1993, BPA published the Resource Programs EIS, a programmatic document that evaluates the environmental tradeoffs among generic resource types and the cumulative effects of adding these resources to the existing system. Based on the Resource Programs EIS, BPA adopted the Emphasize Conservation Alternative. This alternative emphasizes conservation and efficiency improvements, supplemented by renewable and thermal resources, as the most cost-effective and environmentally responsible option for BPA's long-term conservation and generation resource acquisition objectives. As a renewable resource, the project would implement one element of BPA's Emphasize Conservation Alternative. This EIS/EIR will evaluate the site-specific impacts of the proposed project (BPA 1993).

In the face of regional growth and increasing constraints on the existing energy resource base, BPA needs to acquire resources that would contribute to diversification of the long-term power supply prospects in the region. A diverse

resource portfolio is needed to protect BPA and its customers against risk. Towards satisfying this need, BPA has the following agency purposes or objectives:

- Test the ability of geothermal energy in the Fourmile Hill area to provide a reliable, economical, and environmentally acceptable energy resource in the region;
- Assure consistency with BPA's statutory responsibilities, including the Northwest Power Act, while taking into consideration the Council's Conservation and Electric Power Plan and Fish and Wildlife Program;
- Assure consistency with BPA's Resource Programs EIS (BPA 1993) Record of Decision dated April 22, 1993.

1.3 EIS/EIR Information

INTENDED USES OF THE EIS/EIR

The EIS/EIR provides environmental information regarding the effects of proposed actions to the public and Federal, state and local agencies, officials, and decision makers. The National Environmental Policy Act (NEPA) (42 U.S.C. Sections 4321 et seq.) requires Federal agencies to prepare and circulate an EIS for major Federal actions significantly affecting the quality of the human environment, including the natural and physical environment. Similarly, the California Environmental Quality Act (CEQA) Guidelines (14 Cal. Code Reg. Section 15121(a)) state that the intended use of an EIR is to "...inform public agency decision-makers and the public generally of the significant environmental effects of a project, identify possible ways to minimize the significant effects, and describe reasonable alternatives to the project..."

This document is referred to as an EIS/EIR and has been prepared pursuant to United States and State of California statutes discussed above. This EIS/EIR has been prepared as a joint Federal/state environmental document pursuant to 40 CFR 1506.2(c) of the Council of Environmental Quality (CEQ) NEPA Regulations (40 CFR 1500 et seq.) and Section 15222 of the CEQA Guidelines.

The document will be used by the BLM, U.S. Forest Service (USFS), BPA, and Siskiyou County Air Pollution Control District (APCD), as well as a range of responsible agencies, as described in Section 1.4, Agency Roles and Authorizations. The Draft EIS/EIR was distributed for review and comment to the agencies, groups, and individuals listed in Appendix A. Copies of the Draft EIS/EIR were made available for review at the USFS, Modoc National Forest Supervisor's Office in Alturas, California, as well as other USFS offices and the offices of the BLM, Siskiyou County APCD, and BPA. The document was also made available at public libraries in Siskiyou and Modoc Counties, California, and Klamath County, Oregon. See the discussion under "Public Participation on the Draft EIS/EIR" in Section 1.6 for more information on Draft EIS/EIR distribution and public review.

This Final EIS/EIR responds to public and agency comments on the Draft EIS/EIR, and provides necessary clarifications, elaborations, and minor revisions to the Draft EIS/EIR. The Final EIS/EIR has been distributed to all individuals, organizations, and agencies that requested to be kept informed about the project, as well as

individuals, organizations, and agencies that submitted comments on the Draft EIS/EIR. A distribution list for the Final EIS/EIR is provided in Appendix A.

The document has been prepared by a third-party consultant under the direction of the lead and participating agencies, in accordance with BLM NEPA Guidelines 40 CFR 1506.5(c) and CEQA Guidelines Section 15084(d)(4).

INTEGRATION OF NEPA AND CEQA REQUIREMENTS

While NEPA and CEQA encourage the use of integrated documents that meet the need of both Federal and state agencies, neither statute provides specific guidance regarding the format or organization of a joint document. This document is intended to fulfill both the format and content requirements, as well as the spirit, of the two statutes. Much of the organization of this document is based on traditional CEQA document organization, with adjustments made to ensure NEPA compliance.

NEPA uses the term "proposed action" to refer to the act of a Federal agency in either approving or carrying out a project. The CEQA Guidelines define a "project" as "...the whole of an action, which has a potential for resulting in a physical change in the environment..." (CEQA Guidelines Section 15378(d)). The entirety of what is proposed by Calpine will be referred to primarily as the "proposed action" throughout the rest of this joint Federal/state environmental document, since approval of the proposed action is primarily the responsibility of Federal agencies, and state agency approvals comprise a relatively small portion of the Calpine proposal. The terms "proposed action" and "proposed project" may be used interchangeably in the document.

The NEPA terms "affected environment" and "environmental consequences" are used throughout the document. The level of significance of environmental impacts is identified for all project effects, in accordance with CEQA.

Both CEQA and NEPA require that a range of reasonable alternatives be explored and evaluated. Alternatives are introduced at the beginning of the document with the proposed action, and are analyzed in a comparative manner following a discussion of environmental consequences and mitigations for the proposed action. As required by NEPA, the impacts of alternatives are described at a similar level of detail to that of the proposed action.

RELATIONSHIP TO OTHER ENVIRONMENTAL DOCUMENTS

Pursuant to 40 CFR 1502.20, this EIS/EIR is tiered to:

- The USFS Modoc National Forest Land and Resource Management Plan (USFS 1991a) and accompanying EIS (USFS 1991b)
- The USFS Klamath National Forest Land and Resource Management Plan (USFS 1995) and accompanying EIS (USFS 1995)

These Land and Resource Management Plans (LRMPs) provide guidance on natural resource management activities and establish management standards and guidelines for each Forest, and the EISs address the environmental effects of

implementation of each LRMP. Both the LRMPs and EISs acknowledge the potential for geothermal development on the Forests, particularly within the Glass Mountain KGRA. The relationship of the project to the LRMPs is discussed in Sections 3.10 and 4.10 of this EIS/EIR, and information from the LRMPs is summarized in this EIS/EIR where appropriate.

This EIS/EIR is also tiered to the BPA Resource Programs EIS discussed in Section 1.2 (BPA 1993). The Resource Programs EIS is a programmatic document that evaluates the environmental tradeoffs among generic resource types and the cumulative effects of adding these resources to the existing system. Information from the BPA Resource Programs EIS is summarized in this EIS/EIR where appropriate.

Although the proposed project is located on lands managed by the USFS, the subsurface geothermal resources are managed by the BLM, Alturas Resource Office. The BLM Alturas Resource Area Management Plan focuses on surface lands managed by the BLM, and does not address subsurface resources (such as geothermal resources) beneath USFS lands. The relationship of the project to BLM plans and policies is discussed in Sections 3.10 and 4.10 of this EIS/EIR.

This EIS/EIR also summarizes information from the Environmental Assessment (EA) for geothermal leasing in the Glass Mountain KGRA (BLM and USFS 1981) and the Supplemental EA for potential exploration, development, production, and utilization of the geothermal resource (BLM and USFS 1984), where appropriate. Section 1.5 of this EIS/EIR provides more information on these environmental documents.

In 1995, an Environmental Assessment/Initial Study (EA/IS) was prepared for Calpine's proposed geothermal exploration project in the Fourmile Hill vicinity (BLM et al. 1995a). The potential effects from exploration activities at the five proposed production well pads included as part of the proposed action were addressed in this EA/IS, although only two of the five well pads were proposed for use in the exploration project. In addition, the EA/IS addressed potential effects from well pad road construction, as well as from the installation of a temporary hand-laid water pipeline from the Arnica Sink area to the well pad area.

On the basis of the EA/IS, the lead agencies determined that Calpine's exploration project would not have a significant effect on the environment with implementation of identified mitigation measures. The analysis of potential effects at the five production pads and associated access roads and water pipeline contained in the EA/IS are summarized in this EIS/EIR where appropriate. Section 1.5 of the EIS/EIR provides more information on the Fourmile Hill Geothermal Exploration Project and associated EA/IS.

All of the documents discussed in this section are available for review at the USFS, Modoc National Forest Supervisor's Office in Alturas, California.

1.4 Agency Roles and Authorizations

LEAD AGENCIES

The proposed action is under the jurisdiction of the BLM and the U.S. Forest Service (USFS) as the Federal lead agencies, with participation by BPA. The Siskiyou County Air Pollution Control District (APCD) is the CEQA lead agency. These agencies are responsible for overseeing the preparation of this EIS/EIR, and ensuring document and procedural compliance with NEPA and CEQA.

For this project, the BLM, USFS, BPA, and Siskiyou County APCD have entered into a Memorandum of Understanding (MOU) with Calpine Corporation, in accordance with 40 CFR 1501.5(b) and CEQA Guidelines Section 15051(d). The MOU defines the cooperative procedures for completing the environmental review process. The lead agencies are responsible for the preparation and approval of necessary environmental documentation, in this case an EIR/EIS, before final approvals by any agency may occur. A brief description of the lead agencies and their respective roles in the environmental review and permit process follows.

U.S. Bureau of Land Management

The Geothermal Steam Act of 1970 gives the BLM the authority to issue leases for and make determinations on all geothermal activities proposed to be conducted on Federal lands. The BLM decide whether to grant approvals and permits for the proposed action, and is therefore acting as a lead agency. Additionally, the BLM will consider several authorizations for the proposed action and will consider whether to issue the following approvals and permits:

- Approval of the Plan of Utilization (Plant and Support facilities) for the proposed project under 43 CFR 3262.4-1
- Issuance of a two-part Geothermal Utilization Permit (GUP) under 43 CFR 3264.2-1
- Approval of a Site License (SL) under 43 CFR 3250.1-1
- Individual Geothermal Drilling Permits under 43 CFR 3260

U.S. Forest Service

The proposed project is located on the Klamath and Modoc National Forests. As surface managing agency for National Forests, the USFS is participating as a lead agency in the environmental review of the proposed action. In addition, the proposed and alternative transmission line routes cross National Forest lands and are therefore within the jurisdiction of the USFS. The USFS will consider whether to issue the following authorizations to Calpine:

- Right-of-way authorization for the transmission line
- Water well use authorization
- Forest road use authorization

Authorization of the proposed action will require that the USFS make certain amendments to the Klamath and Modoc National Forest LRMPs in order to ensure consistency of the proposed action with these LRMPs. Both LRMPs would be

amended to establish and designate a utility corridor for the transmission line from the proposed Fourmile Hill plant site to the BPA Malin-Warner transmission line. The specific amendment establishing and designating the utility corridor would provide for the avoidance of the following areas:

- Critical habitat for threatened and endangered species
- Wilderness
- Research Natural Areas
- Backcountry Management Areas
- Special Interest Areas (SIAs)
- Areas used in the practice of American Indian religions

In addition, the Klamath National Forest LRMP would be amended to include the following standards and guidelines for the USFS that are already included in the Modoc National Forest LRMP:

- Cooperate with utilities representatives to develop strategies to minimize the potential for single or multiple line power outages that could result from destructive events such as wildfires
- Coordinate with Federal and private utility managers when managing Forest activities near utility corridors to ensure that Forest activities do not conflict with the intended permitted use and management of the utility corridor

Other actions that would be taken by the USFS as a result of USFS authorization of the proposed action would include:

- Issuance of a Forest Order prohibiting the use of firearms in the immediate vicinity of the proposed power plant and wellfield area
- Revise the Klamath National Forest LRMP standard #24-25 to state: Protect traditional Native American cultural and religious uses and practices consistent with Public Law 95-341 (American Indian Religious Freedom Act of 1978).

Bonneville Power Administration

BPA is a Federal agency responsible for purchasing, developing, and marketing electrical power to utility, industrial, and other customers in the Pacific Northwest, pursuant to the Bonneville Project Act of 1937 and the Pacific Northwest Electric Power Planning and Conservation Act. BPA must decide (1) whether it will execute a power purchase agreement with Calpine, and (2) whether it will execute and agreement to transmit (wheel) project output over BPA transmission lines. These decisions will be based on the outcome of this environmental review and other factors. Therefore, BPA is serving as a cooperating Federal agency and is participating in the preparation of the EIS/EIR.

Siskiyou County Air Pollution Control District

Implementation of the proposed POU would also require that Calpine obtain applicable permits from the Siskiyou County APCD. The Siskiyou County APCD has the authority to issue an Authority to Construct (ATC) permit and a Permit to Operate for the proposed action, as the proposed action would include the emission of geothermal steam to the atmosphere during well drilling and operation. As part

of this authorization process, this EIS/EIR will be evaluated by the Siskiyou County APCD to determine whether to issue these permits to Calpine for the project. The Siskiyou County APCD is acting as the lead agency under CEQA, and as such will ensure compliance with CEQA process requirements.

RESPONSIBLE AGENCIES

Federal Energy Regulatory Commission

It is anticipated that the proposed Fourmile Hill Project will meet the criteria for eligibility as a Qualifying Facility as defined by the Public Utility Regulatory Policies Act (PURPA) of 1978. Pursuant to Article 292.207 of PURPA, the owner of a Qualifying Facility may select to conduct self-certification by providing appropriate notices to the Federal Energy Regulatory Commission (FERC) and to the utility that the owner expects to deal with for energy acquisition from the facility. As an alternative, the owner of a Qualifying Facility may choose to file an application for approval certification by FERC. Calpine is currently investigating its options for certification from FERC. Pursuant to Section 210(e) of PURPA, the proposed Fourmile Hill Project (as a Qualifying Facility) is expected to be exempt from state regulation regarding utility rates, as well as from Federal regulation under the Federal Power Act and the Public Utility Holding Company Act (PUHCA).

U.S. Fish and Wildlife Service

Potential habitat for several special status wildlife species (such as the northern spotted owl and bald eagle) exists in the vicinity of the proposed action. U.S. Fish and Wildlife Service (USFWS) staff are therefore being consulted to identify and address potential effects to these species. In addition, a Biological Assessment was submitted to the USFWS in August 1998 for review and concurrence regarding potential effects to threatened and endangered wildlife species.

California Department of Fish and Game

Because there is potential habitat in the project vicinity for special status wildlife species, coordination with the California Department of Fish and Game (CDFG) under the California Endangered Species Act (CESA) is being conducted. In addition, the proposed transmission line included as part of the proposed action may cross some intermittent streams in the project vicinity, and construction of the line could potentially require activities within some intermittent streambeds. Consultations are currently being conducted with the CDFG to determine whether a Streambed Alteration Permit (Fish and Game Code Section 1603) will be required for the proposed action.

Regional Water Quality Control Boards

Under the Clean Water Act, and the California Water Code, the Regional Water Quality Control Boards (RWQCB) in California have the authority to regulate storm water runoff from construction sites and industrial facilities. The proposed power plant and wellfield would be located within the jurisdiction of the North Coast RWQCB, and the proposed action would require a Storm Water Discharge Construction Permit from this RWQCB. In addition, the RWQCB also regulates discharge of waste waters from industrial facilities through the Clean Water Act.

Therefore, Calpine would be required to submit a Report of Waste Discharge to the North Coast RWQCB for the proposed action.

Portions of the proposed transmission line route would be located within the jurisdiction of the Central Valley RWQCB. This RWQCB is therefore being consulted to determine if any additional permits or regulatory action would be required by this agency.

Modoc County

During construction of the proposed action, construction vehicles would primarily use Forest roads, which would be authorized by the USFS through issuance of a Forest road use authorization (see the discussion above regarding USFS authorizations). However, some construction vehicles for the project would use Modoc County Road 97 (under the jurisdiction of Modoc County) to access the plant site and construction areas along the transmission line route. Modoc County may require that Calpine obtain a County Encroachment/Road Use Permit to allow construction vehicle use of this road, and to allow for the connection of this road to the proposed access roads and to construction sites along the transmission line route.

Siskiyou County

Calpine may also be required to obtain a County Encroachment/Road Use Permit from Siskiyou County to allows construction vehicle use of Siskiyou County roads, and to allow for the connection of proposed access roads to County roads.

REQUIRED PERMITS

This EIS/EIR has been prepared pursuant to NEPA and CEQA guidelines. As described above, the Federal and state lead agencies have the principal approval and permit authority for the proposed project. In addition, other responsible agencies also have the authority to grant approvals or permits for the proposed action. Table 1.4-1 identifies the type of permit(s) and/or approval required in order to construct and operate the proposed action, as well as the agency that will be responsible for granting the required permit or approval.

1.5 Previous Geothermal Activity in the Project Area

GEOTHERMAL LEASING AND FORMATION OF THE UNIT AREA

In 1981, the BLM proposed to issue several geothermal leases within the Glass Mountain KGRA for the purpose of exploring, developing, and utilizing the geothermal resource within the KGRA. As part of the authorization process for this leasing, the BLM and the USFS jointly prepared and issued an EA for the "casual use and exploration" of the geothermal resource within the KGRA (BLM and USFS 1981). In 1984, the EA was supplemented to analyze additional potential geothermal leases from expansion of the KGRA and to address the potential environmental effects associated with exploration, development, production, and utilization of the geothermal resource (BLM and USFS 1984). The leases that were issued explicitly provide for the exploration, development, production, and utilization of the leases.

Table 1.4-1: Required Permits and Approvals

Geothermal Facilities	Permitting Agency[1]
• Plan of Utilization	BLM
• Geothermal Utilization Permit	BLM
• Site License	BLM
• Geothermal Drilling Permit (Form 3260-2)	BLM
• Geothermal Sundry Notice (Form 3260-3)	BLM
• Geothermal Well Completion Report (From 3260-4)	BLM
• Qualifying Facility Certification	FERC
Transmission Line	
• Special Use Permit/Easement	USFS
• Power Sales and/or Transmission Access Agreement	BPA/Others
Road Use	
• Road Use Permit	USFS
• County Encroachment/Road Use Permit	Modoc County/ Siskiyou County
Air Quality	
• Authority to Construct	SCAPCD
• Permit to Operate	SCAPCD
Water Quality/Water Use	
• Water Well Use	USFS
• Storm Water Discharge Construction Permit	CVRWQCB
• Report of Waste Discharge	CVRWQCB
• Underground Injection Control Program	EPA
Fish/Wildlife	
• Stream and Lake Alteration Permit (1603)	CDFG
• Section 2090 Consultation	CDFG
• Section 7 Consultation	USFWS

[1] Permitting Agency Legend

BLM	Bureau of Land Management
BPA	Bonneville Power Administration
CDFG	California Department of Fish and Game
NCRWQCB	Central Valley Regional Water Quality Control Board
EPA	U.S. Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
SCAPCD	Siskiyou County Air Pollution Control District
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

SOURCE: MHA Environmental Consulting, Inc.

In 1982, the BLM approved a Unit Agreement for a portion of the Glass Mountain KGRA that designated and delineated the Glass Mountain Unit Area (BLM 1982). The boundaries and lease holdings of the Unit Area are illustrated in Figure 1.5-1. Unit Agreements provide for a cooperative plan among responsible agencies and geothermal exploration companies to explore and potentially develop a geothermal resource. At the time that the Unit Agreement was approved, UNOCAL was designated as the Unit Operator. Other major lease holders in the Unit Area were Occidental Geothermal, Inc. and Phillips Petroleum Company.

Subsequent to approval of the Unit Agreement in 1982, there have been several changes in the geothermal exploration companies interested in exploring the geothermal resource within the Glass Mountain Unit Area. By 1988, the primary lease holders within the Unit Area were UNOCAL and Freeport-McMoRan Resource Partners (FMRP). In 1993, California Energy General Corporation (now CalEnergy Company, Inc.) acquired the UNOCAL leases within the Unit Area and was designated the Unit Operator. In 1994, FMRP designated Calpine Corporation as its agent for geothermal exploration at the Unit Area. In 1996, Calpine acquired the leases from FMRP. Current lease holdings within the Unit Area are illustrated in Figure 1.5-1.

As previously discussed, the proposed power plant facility would be located on Federal geothermal leases CA21924 and CA21926, which are within the boundaries of the Glass Mountain Unit Area. However, based on the 1982 Unit Agreement, these leases are not committed to the Unit. The leases are therefore not subject to Unit requirements, and Calpine is not required to coordinate with the Unit Operator (CalEnergy) for geothermal exploration, development, or utilization activities on these leases (BLM 1982).

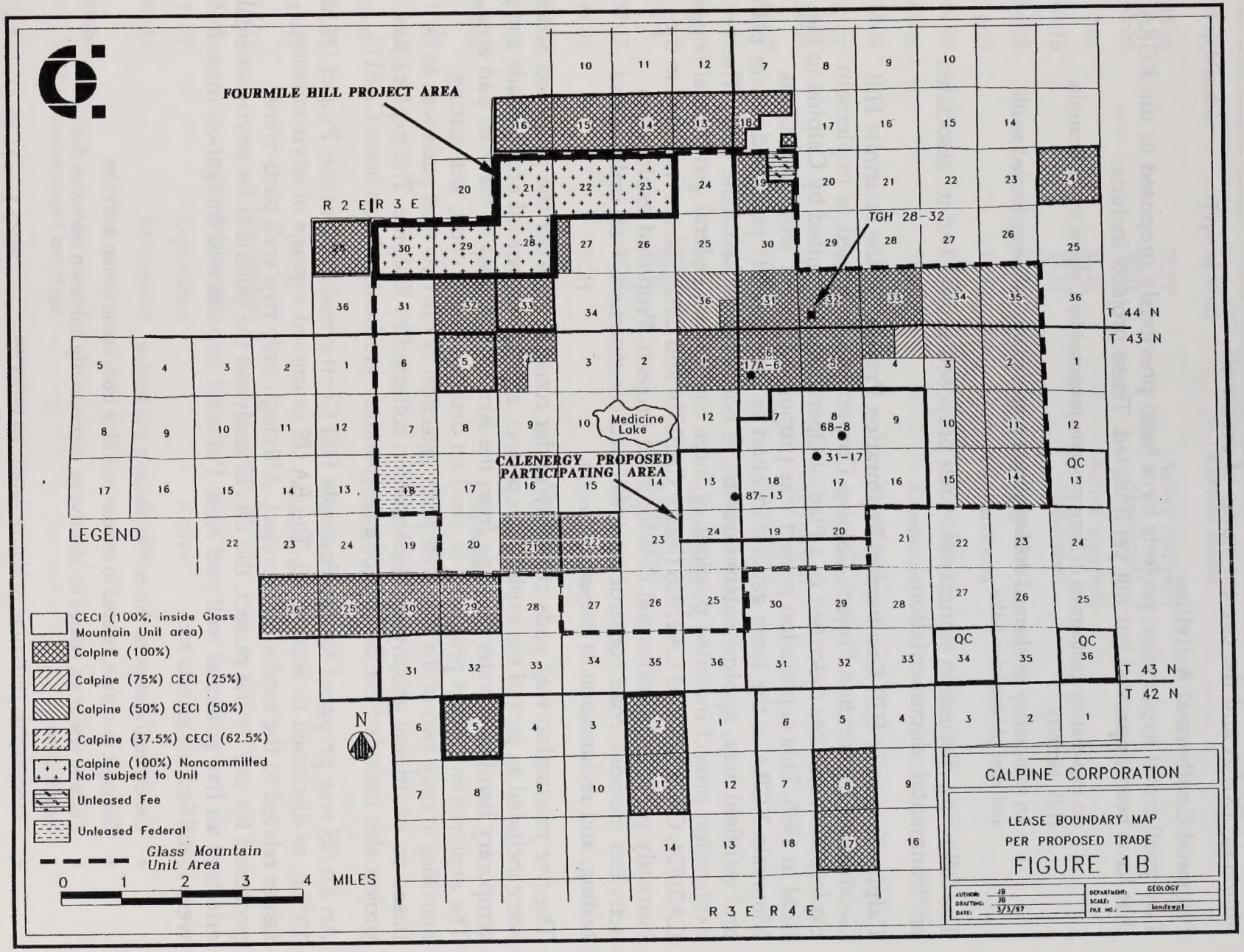
PREVIOUSLY COMPLETED AND PROPOSED GEOTHERMAL ACTIVITIES

Completed Geothermal Activities

Extensive investigations and geophysical surveys of the geothermal resource have been conducted within the Glass Mountain KGRA since 1982. A total of 24 temperature core hole wells were drilled in the Unit Area between 1981 and 1984 (the first phase of exploration). These wells were drilled by UNOCAL, Phillips Petroleum, and Occidental Geothermal, and were used to measure the temperature gradient in the Unit Area.

Based on the results of the temperature gradient drilling, drilling of deep exploration test wells (the second phase of exploration) was initiated in 1984 when Phillips Petroleum and Occidental Geothermal drilled a deep exploration test well at well pad 17A-6 (see Figure 1.5-1). UNOCAL drilled three additional deep exploration test wells between 1985 and 1991 (well pad 68-8 was drilled in 1985, well pad 31-17 was drilled in 1988, and well pad 87-13 was drilled in 1989 and deepened in 1991); the locations of these wells are illustrated in Figure 1.5-1. In 1994, Calpine completed drilling of a temperature core hole well at well pad 88-28 (i.e., the location of the proposed power plant site for the Fourmile Hill Geothermal Development Project).

Figure 1.5-1: Glass Mountain Unit Area Lease Holdings



MHA *Environmental Consulting, Inc.*

SOURCE: Calpine

Table 1.5-1 identifies each of the exploration wells that have been drilled at the Glass Mountain KGRA and the current status of each well.

Proposed Geothermal Activities

Two geothermal exploration projects have been previously proposed in the KGRA that have been approved but not yet initiated. These projects include:

- An exploratory geothermal drilling program proposed by Calpine in the Fourmile Hill vicinity
- An exploratory geothermal drilling project proposed by CalEnergy located south and east of Medicine Lake

The following discussion summarizes each proposed project and its associated environmental documentation.

Calpine Fourmile Hill Geothermal Exploration Project: In the Fourmile Hill Geothermal Exploration Project, Calpine Corporation proposed to implement exploration activities described in a Plan of Operations submitted by Calpine to the BLM in 1995. This exploration project was proposed to occur within the Glass Mountain KGRA at the same general location as the currently proposed power plant and wellfield area, approximately three miles northwest of Medicine Lake. The exploration project included portions of three contiguous Federal geothermal leases: CA21924, CA21925, and CA21926 (leases CA21924 and CA21926 are included in the currently proposed geothermal development project). Proposed exploration activities included road construction, well pad construction, well drilling and testing, and reclamation of the sites.

The five production well pads currently under consideration for the proposed action were included as part of the exploration project, as were associated access roads and a temporary hand-laid water pipeline from the Arnica Sink area to the well pad area. The exploration project proposed to conduct drilling, completion, and testing activities at only two of the five well pads; selection of the two well pads was to be based on additional geophysical information collected by Calpine. The exploration project also included the drilling of a temperature gradient hole on lease CA6111.

An EA/IS was prepared for the Fourmile Hill Geothermal Exploration Project (BLM 1995a), as discussed in Section 1.3. The EA/IS examined a range of environmental issues related to the exploration project. Although only two well pads were proposed for use by the project, the EA/IS analyzed the potential for environmental effects at all five potential well pad sites. Potential impacts and mitigation measures were identified for effects to:

- Geothermal resources, due to well drilling and testing
- Geologic resources, related to erosion resulting from construction activities
- Cultural resources, related to disturbance of previously unknown resources during construction
- Ethnography, pertaining to Native American concerns
- Biological resources, pertaining to effects on plant and animal species of concern

Table 1.5-1: Status of Previously Drilled Geothermal Wells at the Glass Mountain KGRA

Well Number	Type of Well	Current Status
88-28	TCH[1]	Active (capped)
45-36	TCH	Abandoned
28-32	TCH	Active (capped)
68-16	TCH	Abandoned
86-23	TCH	Abandoned
54-19	TCH	Abandoned
62-21	TCH	Abandoned
65-26	TCH	Abandoned
18-34	TCH	Abandoned
27-27	TCH	Abandoned
54-29	TCH	Abandoned
84-17	TCH	Abandoned
36-28	TCH	Abandoned
75-6	TCH	Abandoned
52-4	TCH	Abandoned
57-13	TCH	Abandoned
44-33	TCH	Active (capped)
56-3	TCH	Abandoned
71-20	TCH	Abandoned
52-30	TCH	Abandoned
17-6	TCH	Abandoned
14-23	TCH	Abandoned
56-6	TCH	Abandoned
57-11	TCH	Abandoned
37-19	TCH	Abandoned
17A-6	Exploration	Active
68-8	Exploration	Active
31-17	Exploration	Active
87-13	Exploration	Active

Notes:

[1] TCH = Temperature Core Hole

SOURCE: BLM and USFS

- Air quality, from emissions during construction and during well drilling and testing
- Noise, from construction and drilling operations, and construction vehicle traffic
- Visual resources, due to alteration of views from project construction and site clearing, and light and glare from lighting
- Land use and recreation, due to potential conflicts between recreational uses and development activity

The EA/IS was distributed for public review in December 1995. After review and consideration of public comments, a Finding of No Significant Impact (FONSI) and Decision Record were issued by the BLM and USFS, and a Negative Declaration was prepared by the Siskiyou County APCD. The project was approved in April 1996. Calpine has not yet initiated the proposed exploration.

CalEnergy Glass Mountain Geothermal Exploration Project: CalEnergy has proposed to implement a Plan of Operations for exploratory geothermal drilling within the Glass Mountain KGRA in the Medicine Lake Highlands, on the Modoc and Shasta-Trinity National Forests in Siskiyou County, California. The action was proposed to be located on Federal geothermal leases CA12367, CA12370, CA12371, CA12372, CA1224, and CA2500. The CalEnergy proposal included the construction of five deep exploration well pads, five temperature core hole well pads, associated access roads, and the drilling and testing of exploration wells.

An EA/IS was prepared for the Glass Mountain Geothermal Exploration Project (BLM et al. 1995b). A number of environmental issues and concerns were identified through the scoping process, and were analyzed in the EA/IS. The issues addressed in the EA/IS included:

- Effects to regional geology and sustainability of the geothermal resource
- Effects to the Medicine Lake water table and lake level
- Potential to interfere with the water supply to Medicine Lake
- Native American concerns
- Effects to vegetation from construction of pads and roads
- Effects to threatened and endangered animal species
- Potential health risks from drilling activities (including the release of gases)
- Wind dispersion of drilling emissions
- Noise from operations
- Preservation of scenic resources
- Potential for conflict with tourism and recreation at Medicine Lake
- Effects on area roads
- Effects on property values and local communities
- Potential for local jobs and use of labor from other areas
- Restoration of pads and roads after the project is completed
- Effects from transmission lines and pipelines
- Potential for large-scale development and siting of a power plant

The Glass Mountain EA/IS was distributed for public review in April 1995. After review and consideration of public comments, a FONSI and Decision Record were issued by the BLM and USFS, and a Negative Declaration was prepared by the Siskiyou County APCD. The project was approved in August 1995. However, during the 30-day review period of the FONSI and Decision Record for the EA/IS, the BLM received a letter dated September 18, 1995 from the Klamath Tribes stating their opposition to the proposed Glass Mountain Geothermal Project. Although the Klamath Tribes' letter did not challenge the EA/IS or BLM approval of the FONSI and Decision Record, the BLM considered the Klamath Tribes' letter as an appeal. The BLM reviewed the appeal and determined that the project would not be suspended based on the Klamath Tribes' opposition. CalEnergy has not yet initiated the proposed exploration program.

1.6 Public Participation

PROJECT SCOPING

In order to identify environmental issues and concerns to be addressed in this EIS/EIR, the lead agencies conducted an extensive scoping process for preparation of the Draft EIS/EIR in accordance with NEPA (40 CFR 1501.7 and 40 CFR 1506.6) and CEQA (Public Resources Code Section 21080.4 and CEQA Guidelines Sections 15082 and 15083). The scoping process involved activities such as:

- Distribution of public notices (including mailing of an interested parties notification and publication of public notices in the Federal Register and local newspapers)
- Presentations of project information at public meetings
- Consultations and meetings with specific interested agencies, groups, and individuals

An effort was made to contact all potentially interested responsible agencies, American Indian groups, and members of the public (the Administrative Record for the project contains a copy of the interested parties mailing list). These efforts were intended to build upon the previous public involvement efforts conducted by the lead agencies for previously proposed geothermal projects in the Glass Mountain KGRA.

This section of the EIS/EIR provides an overview of the public participation process and the issues that were raised during scoping. A focused discussion of consultations with American Indian tribes that have been conducted for the proposed action (as well as previously proposed geothermal projects) is provided in Section 1.7 of this chapter, and in Sections 3.6 and 4.6 related to Traditional Cultural Values later in this document.

Public Notices for Draft EIS/EIR Scoping

The scoping process for the Fourmile Hill Geothermal Development Project was formally initiated in June 1996 with publication of public notices and distribution of an Interested Parties (IP) letter. A Notice of Intent (NOI) to prepare an EIS/EIR was published in the Federal Register on June 6, 1996, and a Notice of Preparation (NOP)

for the EIS/EIR was submitted to the California State Clearinghouse on June 7, 1996. In addition, a notification letter was distributed to over 750 agencies, American Indian groups, and members of the public on June 7, 1996 (the interested parties mailing list was included in the Administrative Record for the project). Press releases were issued, and newspaper articles provided coverage of the scoping meetings. Appendix B includes public notices, press releases, and newspaper articles concerning the proposed project and the scoping process.

Scoping Meetings

Public scoping meetings for the proposed action were held at the following locations and dates:

- Yreka, California – Tuesday, June 25, 1996
- Klamath Falls, Oregon – Wednesday, June 26, 1996
- Alturas, California – Thursday, June 27, 1996
- Dorris, California – Thursday, August 22, 1996

At the Yreka scoping meeting, participants expressed interest primarily in the amount of revenue that would be generated as a result of the project, as well as concern regarding the effects on snowmobilers. Individuals attending the Klamath Falls scoping meeting expressed concern regarding visual impacts associated with the transmission line. Individuals also expressed objection to the transmission line near Tionesta and Medicine Lake, and concern about potential noise effects from construction of the transmission line in these areas. Key issues raised at the Alturas public scoping meeting focused on access roads, transmission line impacts, and benefits to local workers. Participants at the Dorris meeting expressed concern regarding the potential effects to surface and groundwater, and potential for effects on regional thermal features in Butte Valley. Individuals also were concerned about air emissions from the proposed power plant and wellfield, particularly hydrogen sulfide (H_2S).

Interested Parties Meetings

In addition to public scoping, focused meetings were held with involved Federal and state agencies to solicit their opinions and concerns about the project. Table 1.6-1 summarizes key meetings that have been held with agencies and interested parties. Meetings and consultations with American Indian tribes are summarized in Section 1.7 of this chapter, and are discussed in detail in the Traditional Cultural Values Sections (Sections 3.6 and 4.6) later in this document.

Key Scoping Issues and Concerns

A total of approximately 60 comment letters were received during the public scoping process for the project. The nature of the oral and written comments received are briefly summarized by topic in the sections below. Table 1.6-2 summarizes the key issues raised during scoping, both in comment letters that were received and at the public and interested parties scoping meetings. Detailed information regarding the current conditions for these key issues is provided in Chapter 3 of this document, and these issues are thoroughly discussed in the environmental analysis contained

Table 1.6-1: Scoping Meetings with Interested Parties

Agency/Group	Date/Location	Issues
Siskiyou County Board of Supervisors	June 25, 1996 Yreka, CA	Expressed interest in the amount of expected revenue generated from the project. Requested that the County remain involved throughout the environmental review process.
Lava Beds National Monument staff	June 26, 1996 Lava Beds Headquarters	Concerned that the project may affect the overall visitor experience. Visual impact, access routes, air quality impacts, and noise impacts should be addressed.
Modoc National Forest, Doublehead District Ranger	June 27, 1996 Tulelake, CA	Concerns related to recreational use and alternative transmission line routes should be addressed.
Scott Kestler of the Modoc County Land Use Committee	June 28, 1996 Alturas, CA	Interested in associated impacts to recreation, grazing access, and socioeconomics.
California Department of Fish and Game and U.S. Fish and Wildlife Service	August 21, 1996 Macdoel, CA	Discussion of key biological issues for the project, including surveys for spotted owls and bats.
Siskiyou County representatives	August 22, 1996 Yreka, CA	Interested in details of project action and associated impacts, including production of sulfur and effects on endangered species.

SOURCE: MHA Environmental Consulting, Inc.

Table 1.6-2: Key Issues Raised During Scoping

Topic	Issues / Concerns
Hydrology	Potential effects to Medicine Lake water quality and quantity; effects to regional water quality and quantity
Geothermal Resources	Potential effects to regional thermal features
Cultural Resources	Effects to historic and archaeological resources
Traditional Cultural Values	Direct effects to traditional cultural sites; effects on access to traditional cultural sites; effects on traditional American Indian cultural and religious values and uses
Vegetation	The extent and effect of vegetation removal; effects to special-status plant species and old growth forest (late seral areas)
Wildlife	Loss of wildlife habitat; effects to special-status wildlife species (and habitat use) such as northern spotted owl, northern goshawk, and bats
Visual Resources	Visual effect of transmission line crossings of visually sensitive roads; effect on views from Medicine Lake, Tionesta, and Lava Beds National Monument
Plans and Policies	Disturbance of roadless release areas
Land Use/Recreation	Effects on developed recreation and residences at Medicine Lake; effects on snowmobiling
Air Quality	Effect of construction dust at Medicine Lake and Tionesta; effect of power plant emissions
Noise	Construction and operation noise effects at Medicine Lake; construction noise effects at Tionesta

SOURCE: MHA Environmental Consulting, Inc.

in Chapter 4. The other issues raised during scoping are also discussed in other sections of this document.

EIS/EIR Process: Questions and comments were raised regarding the role of the USFS, the National Park Service, and the BLM in preparing the EIS/EIR and in the project approval process. Questions were raised regarding the environmental review process, including who is financing the EIS/EIR, whether mitigation would be included, and how public comments will be used.

Proposed Action: Many questions were raised regarding the construction and operation of the proposed project including the wells, pipelines, power plant, and transmission line. Questions were raised regarding the overall area of land that would be disturbed for all facilities, the number and need for all of the wells, pipeline safety and failure, the flow rate of water through the plant, and the generation of wastes from proposed facilities. Comments were received requesting that the EIS/EIR analyze alternative transmission line routes, including an alignment which would avoid the Medicine Lake area and an alternative transmission line route north or south of Tionesta.

Geology and Soils: Comments and questions related to the need to protect existing geologic conditions and formations (e.g. Glass Mountain, Little Glass Mountain, Medicine Lake, and surrounding lava flows), as well as untapped geologic resources and potential mining opportunities.

Geothermal Resources and Thermal Features: Concerns were raised regarding the effects of the project on geothermal resources and thermal features (hot springs and wells) in the project region. Concerns related to the potential effects of plant operation (injection effects) on the quality of the geothermal resource and downstream groundwater quality were raised. Groundwater supply concerns related to the potential for drawdown of the local water table and potential effects on domestic water supplies were raised.

Hydrology: Concerns regarding hydrology were primarily related to the potential effect of the project on Medicine Lake water quality and quantity, as well as more regional effects on water quality and quantity. Other comments and questions raised regarding hydrologic resources included the availability of water for domestic use, the impacts that drilling may have on the surrounding aquifers and aquatic systems, and the project's relationship to the *Water Quality Control Plan for the North Coast Region* (RWQCB 1994).

Cultural Resources: Comments received regarding cultural resources indicated that a thorough evaluation of cultural, historic, and archeological resources should be provided.

Traditional Cultural Values: Concerns were expressed about the protection of American Indian values and spiritual sites in and around the Medicine Lake area. See also the American Indian Consultation subsection in Section 1.7 of this chapter, and the discussions of Traditional Cultural Values in Sections 3.6 and 4.6 later in this document.

Vegetation: Questions were raised regarding the extent and effect of vegetation removal associated with transmission line construction. Concerns were expressed about the extent of logging of old growth forests that would be required, how vegetation removal would be conducted (i.e. burning or clear cutting), and how invasive non-native species would be controlled.

Wildlife: Concerns were expressed about the extent and effect of the removal of habitat for wildlife species due to transmission line construction. Concerns were expressed about the potential for the project to affect special-status wildlife species (such as northern spotted owl, northern goshawk, and bats) through habitat disturbance and loss.

Visual Resources: Visual resource concerns related to the potential for the project to affect the scenic resources in the Medicine Lake Highlands and views from Lava Beds National Monument and Tionesta. Concerns were also expressed about views of the transmission line at crossings of visually sensitive roads. Comments indicated that the visual analysis should address the impact of night lighting and the visibility of the power plant and plume from a range of regional vantage points.

Plans and Policies: Several comments received reflect concern about the project's potential to disturb released roadless areas on the Forest, particularly the Mount Hoffman released roadless area. Comments were also received regarding compliance with the Northwest Forest Plan, Forest Management Practices, and the California Forest Practice Rules.

Land Use and Recreation: Concerns were expressed about the project's potential to affect or disturb existing developed recreational uses and residences at Medicine Lake. Comments were also received regarding the potential effect on snowmobiling uses and trails in the project vicinity.

Transportation: Questions were raised regarding the location and number of project access roads along the transmission line and to the power plant, and whether roads would remain open year-round and be accessible to the public. Other transportation concerns were the identification of responsibility for road maintenance, and the potential effect of locked gates on recreation.

Air Quality: Air quality concerns were related to the potential for impacts from the operation of the proposed power plant and the potential impacts from associated heavy metals and H_2S that may be present in the vented steam. Potential effects from project construction dust at Medicine Lake and Tionesta were also of concern, as were the effect on ambient air quality of emissions from increased traffic and the need for compliance with Class I airshed standards at the Lava Beds National Monument.

Noise: Concerns were raised about the potential noise-related impacts associated with construction and operation of the proposed facilities. These concerns primarily focused on potential noise effects at Medicine Lake and Tionesta.

Human Health and Safety: Health and safety concerns focused on the effects of transmission line electromagnetic fields, worker safety and health, hazardous materials release, and wildland fire protection.

Socioeconomics: Public comments indicate concerns about how the project would benefit the local community in terms of local employment and tax revenues. Concerns were also raised regarding whether a decrease in local property values could occur.

Cumulative Impacts: Individuals requested that cumulative impact issues be addressed, including future development that may result from the approval and success of the proposed project, the effects from year-round access to the Medicine Lake Highlands, the long-term effects of the project on biological resources, and the effects of other potential geothermal projects in the area.

PUBLIC PARTICIPATION ON THE DRAFT EIS/EIR

Both NEPA and CEQA require that a Draft EIS/EIR be made available to the public for review and comment. NEPA encourages the solicitation of comments on a Draft EIS from individuals or organizations that may be interested or affected by a proposed project, and CEQA requires that notices of the availability of a Draft EIR be made to all individuals and organizations that have requested such notice. The goal is to provide the public with an opportunity for meaningful review of the Draft EIS/EIR, as well as an opportunity to comment on the potential environmental effects of a proposed project. Both NEPA and CEQA allow for public hearings to be held at the discretion of the lead agencies, but such meetings are not required.

This Final EIS/EIR is an informational document prepared by the lead agencies, that must be considered by decision makers before these agencies can approve or deny their respective discretionary permits for the project. Both NEPA and CEQA require that substantive comments on a Draft EIS/EIR shall be included in the Final EIS/EIR, and that responses to these comments be provided. This document has been prepared pursuant to these requirements of NEPA and CEQA.

Public Noticing

The lead agencies conducted an extensive public participation program in accordance with NEPA and CEQA. The program was designed to assist the lead agencies in fully addressing the public's concerns about the environmental impacts of the proposed project, and obtaining comments on the adequacy of the environmental analysis in the Draft EIS/EIR.

Public notices were issued at several stages in the preparation of the Draft EIS/EIR to ensure that the public had adequate opportunities to learn about the project and express their concerns about environmental issues. The following public notices were issued:

- In June 1996, an Interested Parties letter was mailed to approximately 800 individuals, agencies, and groups as part of the scoping process; this letter included a return mailer to the USFS that allowed Interested Parties to request to be kept on the mailing list and notified of the project and Draft EIS/EIR.

- On July 11, 1997, a Notice of Completion for the Draft EIS/EIR was submitted to the State Clearinghouse.
- On July 11, 1997, a request was submitted to the EPA for filing of a notice of availability for the Draft EIS/EIR in the Federal Register.
- On July 16, 1997, the USFS issued a news release regarding the availability of the Draft EIS/EIR and the beginning of the public review period for the document.
- On July 18, 1997, the EPA filed a notice of availability for the Draft EIS/EIR in the Federal Register, which officially began the public review period for the document.

Draft EIS/EIR Distribution

A total of more than 375 copies of the Draft EIS/EIR for the Fourmile Hill project were distributed to approximately 330 individuals, agencies and groups. The Draft EIS/EIR was initially distributed for public and agency review on July 10, 1997. At that time, copies of the Draft EIS/EIR were sent to each individual, agency, and organization that requested to be kept notified of the project and Draft EIS/EIR, as well as those individuals, agencies, and organizations that specifically requested a copy of the Draft EIS/EIR.

Subsequent to the Draft EIS/EIR release date, additional requests for copies of the Draft EIS/EIR were received by the lead agencies. Approximately 45 copies of the Draft EIS/EIR were distributed in response to these requests.

The Draft EIS/EIR was also made available for public review at all of the lead and cooperating agency offices, including:

- USFS offices in Alturas, Macdoel, and Tulelake
- BLM offices in Alturas
- Siskiyou County APCD offices in Yreka
- BPA offices in Portland, Oregon

In addition, the Draft EIS/EIR was available for public review at public libraries in Siskiyou and Modoc Counties, California, and Klamath County, Oregon.

Public Review Period

Following distribution of the Draft EIS/EIR, a public review period was held during which the public could review and comment on the Draft EIS/EIR. Although the Draft EIS/EIR was distributed on July 10, 1997, the public review period for the document officially began on July 18, 1997 when the EPA published a Notice of Availability for the Draft EIS/EIR in the Federal Register.

The lead agencies initially intended to hold a 60-day public review period for the Draft EIS/EIR. The review period was scheduled to close on September 16, 1997. In response to numerous requests, however, the public review period was extended by two weeks and officially was closed on September 30, 1997. Notice of the review period extension was provided on September 10, 1997 to all recipients of this extension. Thus, the official public review period for the Draft EIS/EIR was 74 days.

A total of 270 comment letters were received on the Draft EIS/EIR, and five public hearings were held. Approximately 2,300 individual comments have been identified from the comment letters and public hearings. Summary of the issues raised in the Draft EIS/EIR can be found in the Executive Summary and in Chapter 1 of Volume III of this Final EIS/EIR.

Public Hearings

Public hearings to receive comments on the Draft EIS/EIR were held at the following locations:

- Dorris, California on August 5, 1997
- Klamath Falls, Oregon on August 6, 1997
- Yreka, California on August 7, 1997
- Mount Shasta, California on August 29, 1997
- Medicine Lake, California on August 30, 1997

Meetings with Agencies

In addition to the five public hearings, several meetings were held with interested agencies to discuss comments and questions related to the Draft EIS/EIR. Meetings were held with staff from the following agencies:

- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- National Park Service, Lava Beds National Monument
- North Coast Regional Water Quality Control Board
- Central Valley Regional Water Quality Control Board
- California Department of Fish and Game
- Siskiyou County

1.7 American Indian Consultation

REGULATIONS

Several laws and Executive Orders address the issue of consultation with local American Indian groups regarding any proposed project that may affect traditional religious practices or cultural resources, including:

- National Historic Preservation Act of 1996, as amended
- American Indian Religious Freedom Act of 1978
- Executive Order 12898
- Executive Order 13007
- National Environmental Policy Act
- California Environmental Quality Act

These Federal and state laws and the Executive Orders are described in this EIS/EIR in Section 4.6, Traditional Cultural Values.

Various American Indian tribes have submitted tribal claims for Forest lands in the project vicinity. It has been determined that these lands are Federal lands that are to be managed by the appropriate Federal agency (i.e., the USFS). In addition, the American Indian tribes have no legal approval authority over the proposed project.

CONSULTATION

In accordance with the consultations requirements identified above, consultations with local American Indian groups have been conducted regarding the proposed action, and are on-going. The Klamath & Modoc National Forests do not currently have government-to-government agreements with the Pit River Tribe or the Klamath Tribes. Both Forests are working toward government-to-government agreements. In the interim, the Forests are working in the spirit of such agreements and are attempting to meet the intent of such agreements. The use of the term "government-to-government" in this document is meant to convey the intent of the consultations.

The following discussion summarizes the issues and concerns raised by American Indian groups during project consultations.

Scoping Consultation

Three meetings were conducted between October 1995 and April 1996 with representatives from the Klamath Tribes and the Shasta group at Butte Valley and with a Pit River Tribal representative. A presentation was also made to Pit River Tribal Council members regarding the proposed action in April 1996. Three meetings were subsequently held between June and July 1996 with the Klamath Tribes Cultural Heritage Committee and with Tribal members of the Ajumawi and Atwamsini Bands of the Pit River Tribes. A site visit was held in September 1996. In March 1997, the ethnographic reports for the proposed project were provided to the tribes for review and comment. Follow-up meetings were held with the tribes in June 1997 to obtain their input on the reports. Additional meetings were held to solicit tribal comments on the Draft EIS/EIR.

Issues raised during these meetings indicate that representatives of these tribes have concerns that the geothermal operations would impact spiritual activities and religious practices in the Medicine Lake Highlands and would impact cultural resource sites along the transmission line. There were also concerns raised that the visual and noise effects of the project would alter the natural tranquillity and beauty of the area and affect religious practices. Effects on wildlife and water quality were also of concern.

Opposition to the project was noted and related primarily to the interruption and degradation of religious activities, spiritual values, gathering, and use of the area. A comment was made that mitigation for the loss of ability to practice spiritual activities should be provided. Several commentors suggested that a Cultural Management Plan should be developed. Commentors also indicated that a Memorandum of Understanding be established between the Pit River Tribes and the Modoc National Forest. The Pit River Nation issued a resolution that the project should not be approved without approval from the Pit River Nation (as discussed

previously, American Indian tribes have no legal approval authority over the proposed project). The Heritage Committee of the Klamath Tribes has also stated that the project should not be approved because of the effects to Native American religious values.

On-going Consultation

Several meetings with the tribes were held after the Draft EIS/EIR was released for public review in July 1997. Tribal concerns about the project, the Draft EIS/EIR, and other issues were discussed during these meetings. Concerns raised during these meetings were generally the same as the concerns expressed by the tribes during public scoping consultations.

Meetings with the Klamath Tribes (after distribution of the Draft EIS/EIR) were held on the following dates:

- August 6, 1997
- September 9-13, 1997 (ethnographic interviews with tribal members)
- October 6-11, 1997 (ethnographic interviews with tribal members)
- November 2-4, 1997 (ethnographic interviews with tribal members)
- April 1, 1998

Meetings with the Pit River Tribe (after the distribution of the Draft EIS/EIR) were held on the following dates:

- September 9-13, 1997 (ethnographic interviews with tribal members)
- October 3, 1997
- October 6-11, 1997 (ethnographic interviews with tribal members)
- November 2-4, 1997 (ethnographic interviews with tribal members)
- March 17, 1998
- April 10, 1998

Consultations with the Klamath and Pit River Tribes regarding the project will continue through the time when a decision is made for the project.

Ethnographic Report

In addition to the USFS and BLM meetings with the tribes, the EIS/EIR analysis included an ethnography study of the project region. The study was conducted in two phases in 1996 and 1997. Phase I of the study included a literature search and interviews with tribal members. Phase II of the study included additional interviews with tribal members, additional literature and record review, and field verification of data gathered from interviews. The results of the study are described in *Medicine Lake Highland and Timber Mountain Ethnographic Report for the Fourmile Hill Geothermal Development Project, Siskiyou and Modoc Counties, California* (Theodoratus, et al. 1998). Tribal consultation and tribal concerns are further described in Sections 3.6 and 4.6 of this EIS/EIR.

2: ALTERNATIVES, INCLUDING THE PROPOSED PROJECT

2: ALTERNATIVES, INCLUDING THE PROPOSED ACTION

This Chapter of the EIS/EIR presents detailed information about the proposed action and alternatives to the proposed action. Section 2.1 provides a discussion of how the range of project alternatives considered in this EIS/EIR was developed. Section 2.2 describes Alternative 1, which is the proposed action. Section 2.3 identifies alternatives to the proposed action, including the no action alternative. Section 2.4 provides a comparative analysis of the environmental effects of the proposed action and alternatives. Section 2.5 provides information on alternatives that have been considered but rejected from detailed analysis in this EIS/EIR.

2.1 Overview of Alternatives Development

NEPA AND CEQA REQUIREMENTS FOR ALTERNATIVES

Both NEPA and CEQA require that the lead agency for a proposed project consider a reasonable range of alternatives to the proposed project that could feasibly attain the basic objectives of the project as defined in the purpose and need for the project (40 CFR 1502.14(a) and CEQA Guidelines Section 15126(d)). The development of a reasonable range of alternatives is governed by the "rule of reason," which requires that the EIS/EIR set forth only those alternatives necessary to permit a reasoned choice.

The purpose of looking at alternatives to the proposed action is to describe the opportunities and trade-offs of different approaches to the project in order to assist the lead and cooperating agencies in making reasoned decisions. The EIS/EIR need not consider an alternative for which effects cannot be reasonably ascertained or when its implementation is remote and speculative (CEQA Guidelines Section 15126(d)(5)(C)). Under NEPA, reasonable alternatives are considered to be those that are practical or feasible from a common sense, technical, environmental, and economic standpoint (40 CFR 1502.14(a)). Under CEQA, an EIR should focus on alternatives that would eliminate significant adverse environmental effects or would reduce these effects to a level of insignificance, even if these alternatives would somewhat impede the attainment of project objectives or be more costly (CEQA Guidelines Section 15126(d)(1)).

The range of alternatives to the proposal submitted by Calpine is limited to those alternatives that meet the basic purpose and need (objectives) for the proposed action and are considered to be reasonable alternatives. To meet the purpose and need for the proposed Calpine project, and to be within the scope of this analysis, the alternatives under consideration in this document are limited to those alternatives that are:

- A geothermal development project
- Located on the Calpine Federal geothermal leases
- Located in areas of the lease with the geologic probability of encountering the geothermal reservoir fractures through vertical or slant (directional) drilling
- Located in areas that could accommodate the proposed facilities (wells, pipelines, power plant, transmission line) with sound engineering and environmental practices
- Designed to use technically feasible geothermal power generation technologies
- Economically feasible and viable

ALTERNATIVES DEVELOPMENT PROCESS

In order to initiate the alternatives development process, Calpine and the lead agencies first refined the proposed action (designed by Calpine to meet the criteria described above) that was submitted by Calpine in the Plan of Utilization (Calpine 1995). Existing information on environmental constraints and sensitive resources was taken into consideration during project siting and definition. Alternatives were then developed to address environmental issues, as well as concerns raised during the public scoping process (see Chapter 1, Sections 1.6 and 1.7 for more information on public scoping and a summary of the key issues that were raised). The development of alternatives was also based on the criteria described above. The following discussion describes the alternatives development process that was conducted for the proposed action.

Definition of the Proposed Action

Power Plant and Wellfield: The siting of the proposed power plant and wellfield was constrained by the expected location of the geothermal reservoir and Calpine's geothermal leases. Previous geologic and geophysical studies in the project area, as well as Calpine's own geothermal exploration activities, have provided an indication of the location and extent of the geothermal reservoir (this information is considered to be proprietary by Calpine). The power plant was sited in the only location that allows reasonable access to the geothermal resource and that is (or could reasonably be expected to be) under lease to Calpine. Within this limitation, the well pads and power plant were sited to take maximum advantage of existing roads and surface disturbance, to minimize additional surface disturbance, and to consider environmental and engineering constraints.

The proposed wellfield was sited by Calpine primarily based on geologic and geophysical studies that identified the drilling locations on their leases with the greatest probability of encountering the geothermal reservoir fractures and a commercially viable resource. Calpine's next objective was to site the power plant on their leases within one mile of the proposed wells (BLM et al. 1995). After consideration of the geologic data, Calpine identified preliminary locations for proposed production and

injection well pads and the power plant, as discussed in the Plan of Utilization (POU) for the proposed action (Calpine 1995).

The locations of all power plant and wellfield facilities were then reviewed with the USFS to ensure that potential environmental effects were minimized. For example, a northern goshawk nest area was identified in the vicinity of some of the proposed well pads. The northern goshawk is a special status wildlife species, and the USFS was concerned that project activities could affect nesting if located too close to the nesting area (see Sections 3.8 and 4.8 for more information on this species). In consultation with the USFS, these well pads were relocated to avoid the goshawk nesting area. The relocated pads were field reviewed to ensure that no sensitive cultural or botanical resources exist at the relocated pad locations. Section 2.2 provides specific information regarding the proposed action.

Transmission Line: During preliminary design activities, Calpine identified a transmission line corridor for the proposed action that extends from the proposed power plant and wellfield area to a connection with the BPA Malin-Warner transmission line, located approximately 24 miles east of the power plant and wellfield area. A transmission line corridor heading east from the power plant was identified primarily due to constraints in locating a transmission line to the north, west, or south (see Section 2.4 for more information on why these alternatives were rejected from detailed consideration). The proposed transmission line route was developed in consultation with the USFS to minimize probable environmental effects through careful siting and by minimizing the length of the transmission line.

Development of Project Alternatives

Alternatives to the proposed action are limited to transmission line alternatives due the constraints in siting the proposed geothermal power plant and wellfield. No feasible alternative locations exist for these facilities because of the need to be within the geothermal lease. The power plant was sited by Calpine to minimize environmental impacts; no other sites are available within the lease area that would reduce or avoid effects. This alternatives development approach is consistent with the alternatives consideration discussed in the CEQA Guidelines, which identifies geothermal power plants as an example of a project for which there may be no feasible alternative location (CEQA Guidelines Section 15126(d)(5)(B)(2)).

The transmission line alternatives for the proposed action were developed as a result of Calpine's initial siting analysis conducted for the proposed action, as described above, and in response to environmental issues and community concerns raised during scoping. Each key issue that was identified during the public participation and scoping process (see Chapter 1) was considered in the development of alternatives to the Fourmile Hill Geothermal Development Project. The various elements of the project (facility, locations, design elements, etc.) were reviewed after scoping to determine if alternatives could be developed that would respond to issues and reduce environmental effects. The types of alternatives considered during this process included:

- Alternate transmission line routes
- Alternate transmission line design, capacity, and construction methods

From the types of alternatives considered during this process, a reasonable range of alternatives was developed for detailed consideration in this EIS/EIR. This range was based on the ability of the alternative to meet the purpose and need for the project and reduce adverse environmental effects. The technical and economic feasibility of the alternative was also considered. Alternatives that meet these objectives include several alternative transmission line routes that are considered in detail in the EIS/EIR. A "No Action" alternative is also evaluated in order to provide a baseline for comparing alternatives. The alternative transmission line routes and the No Action alternative are discussed in Section 2.3, Alternatives to the Proposed Action.

Alternatives that do not meet the purpose and need for the project, that are not technically feasible, or that do not address the issues raised during the scoping process, have been eliminated from further consideration in this EIS/EIR. These alternatives, including additional alternate transmission line routes, buried transmission lines, smaller transmission line capacity, buried pipelines, and alternate geothermal power plant locations and technologies, are discussed in Section 2.5, Alternatives Considered but Eliminated from Detailed Study.

2.2 Alternative 1—Proposed Action

The proposed action, the Fourmile Hill Geothermal Development Project, is to construct and operate a 49.9 megawatt (MW) (gross) geothermal power plant, with associated production and injection wells, well pads, pipelines, transmission line, and access roads, on leases CA21924 and CA21926 in the Glass Mountain KGRA on the Klamath and Modoc National Forests in Siskiyou and Modoc Counties, California (see Figure 2.2-1). This section provides specific information about the various elements of the proposed action:

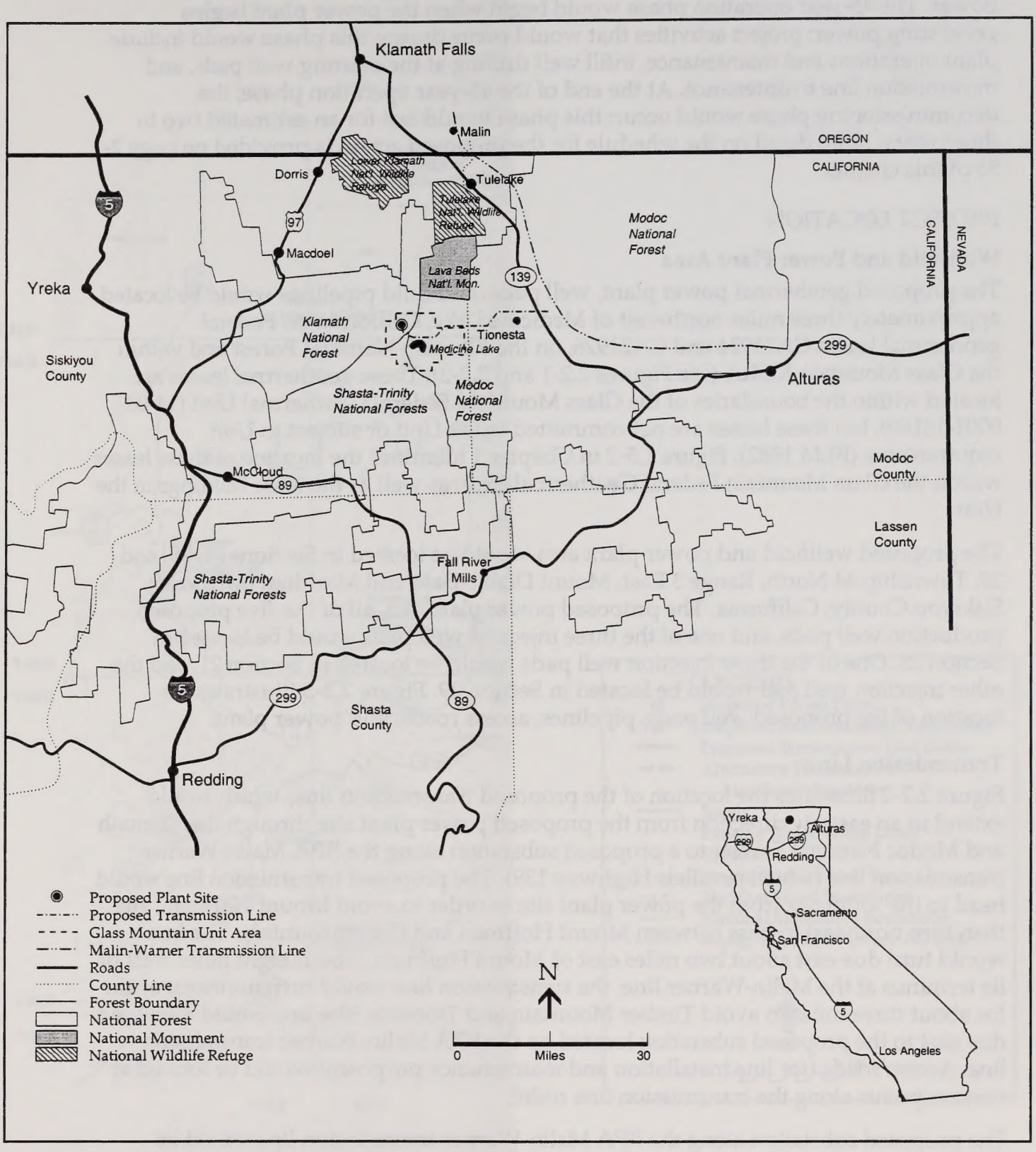
- Project location
- Overview of the proposed action
- Construction and operation of the wellfield (including production and injection wells and well pads, pipelines, and access roads)
- Construction and operation of the power plant
- Construction and maintenance of the transmission line (including the substation and access roads)
- Project decommissioning
- Project schedule, manpower requirements, and projected economic benefits

The proposed action would occur in three defined phases:

- Construction
- Operation
- Decommissioning

The project construction phase would be the first phase of the proposed action, and would occur over a 3-year period. This phase would begin with initial wellfield construction activities, and would end when all proposed project facilities have been

Figure 2.2-1: Regional Location Map



constructed and the geothermal power plant is ready to begin operations and generate power. The 45-year operation phase would begin when the power plant begins generating power; project activities that would occur during this phase would include plant operations and maintenance, infill well drilling at the existing well pads, and transmission line maintenance. At the end of the 45-year operation phase, the decommissioning phase would occur; this phase would last for an estimated two to three years. More detail on the schedule for the proposed action is provided on page 2-55 of this chapter.

PROJECT LOCATION

Wellfield and Power Plant Area

The proposed geothermal power plant, well pads, and fluid pipelines would be located approximately three miles northwest of Medicine Lake, California on Federal geothermal leases CA21924 and CA21926, on the Klamath National Forest and within the Glass Mountain KGRA (see Figures 2.2-1 and 2.2-2). These geothermal leases are located within the boundaries of the Glass Mountain Federal Geothermal Unit (14-08-0001-18160), but these leases are not committed to the Unit or subject to Unit requirements (BLM 1982). Figure 1.5-2 in Chapter 1 identifies the location of these leases within the Glass Mountain Federal Geothermal Unit, as well as the lease holdings in the Unit.

The proposed wellfield and power plant area would be located in Sections 21, 28, and 29, Township 44 North, Range 3 East, Mount Diablo Base and Meridian (MDB&M), Siskiyou County, California. The proposed power plant site, all of the five proposed production well pads, and one of the three injection well pads would be located in Section 28. One of the three injection well pads would be located in Section 21, and the other injection well pad would be located in Section 29. Figure 2.2-3 illustrates the location of the proposed well pads, pipelines, access roads, and power plant.

Transmission Line

Figure 2.2-2 illustrates the location of the proposed transmission line, which would extend in an easterly direction from the proposed power plant site through the Klamath and Modoc National Forests to a proposed substation along the BPA Malin-Warner transmission line (which parallels Highway 139). The proposed transmission line would head to the southeast from the power plant site in order to avoid Mount Hoffman, and then turn northeast to pass between Mount Hoffman and Glass Mountain. The line would turn due east about two miles east of Mount Hoffman. About eight miles west of its terminus at the Malin-Warner line, the transmission line would turn northeast again for about three miles to avoid Timber Mountain and Tionesta. The line would then head due east to the proposed substation located on the BPA Malin-Warner transmission line. Access roads (for line installation and maintenance purposes) would be located at various points along the transmission line route.

The proposed substation along the BPA Malin-Warner transmission line would be located on the Modoc National Forest near Perez, California (see Figure 2.2-2).

Figure 2.2-2: Proposed Power Plant and Transmission Line Route

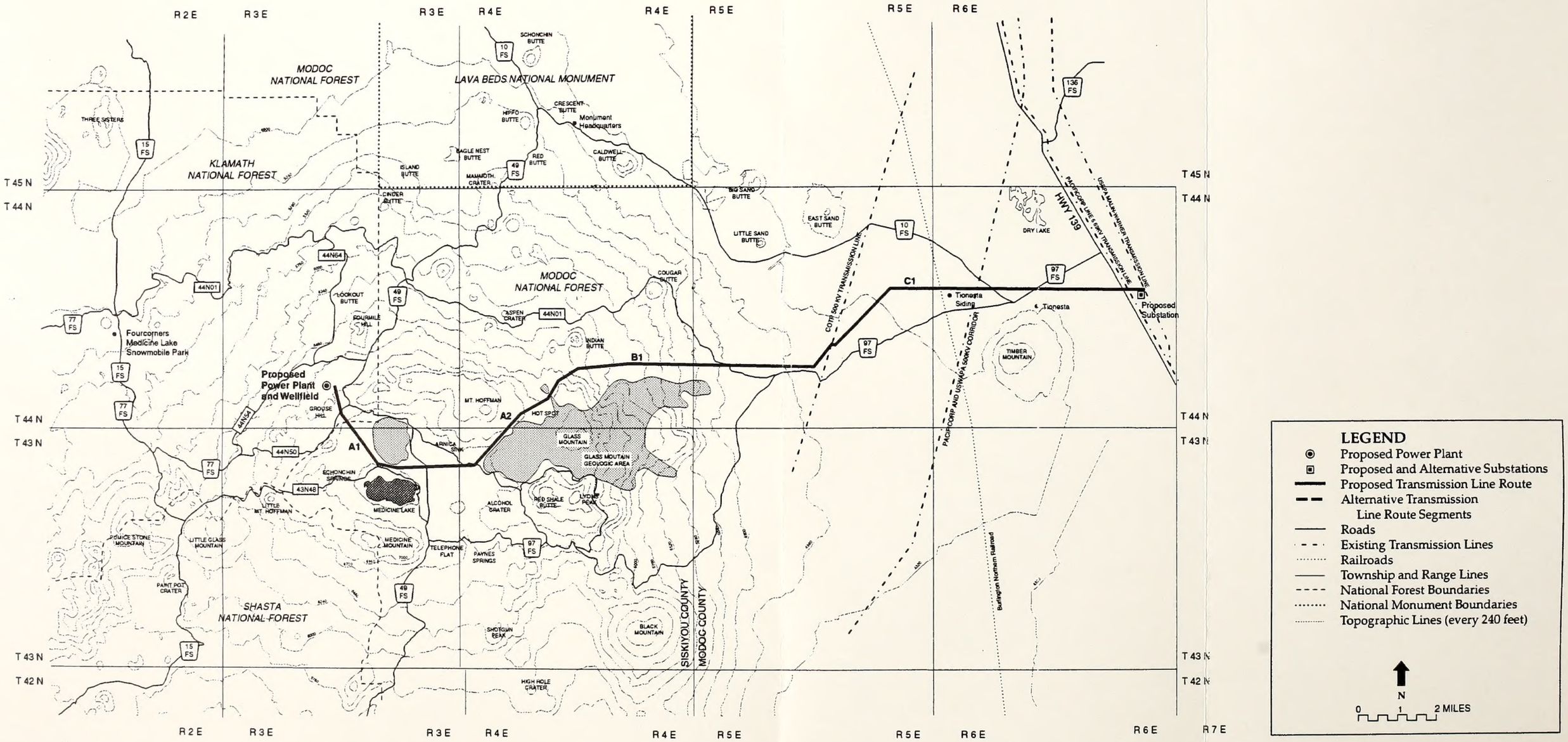
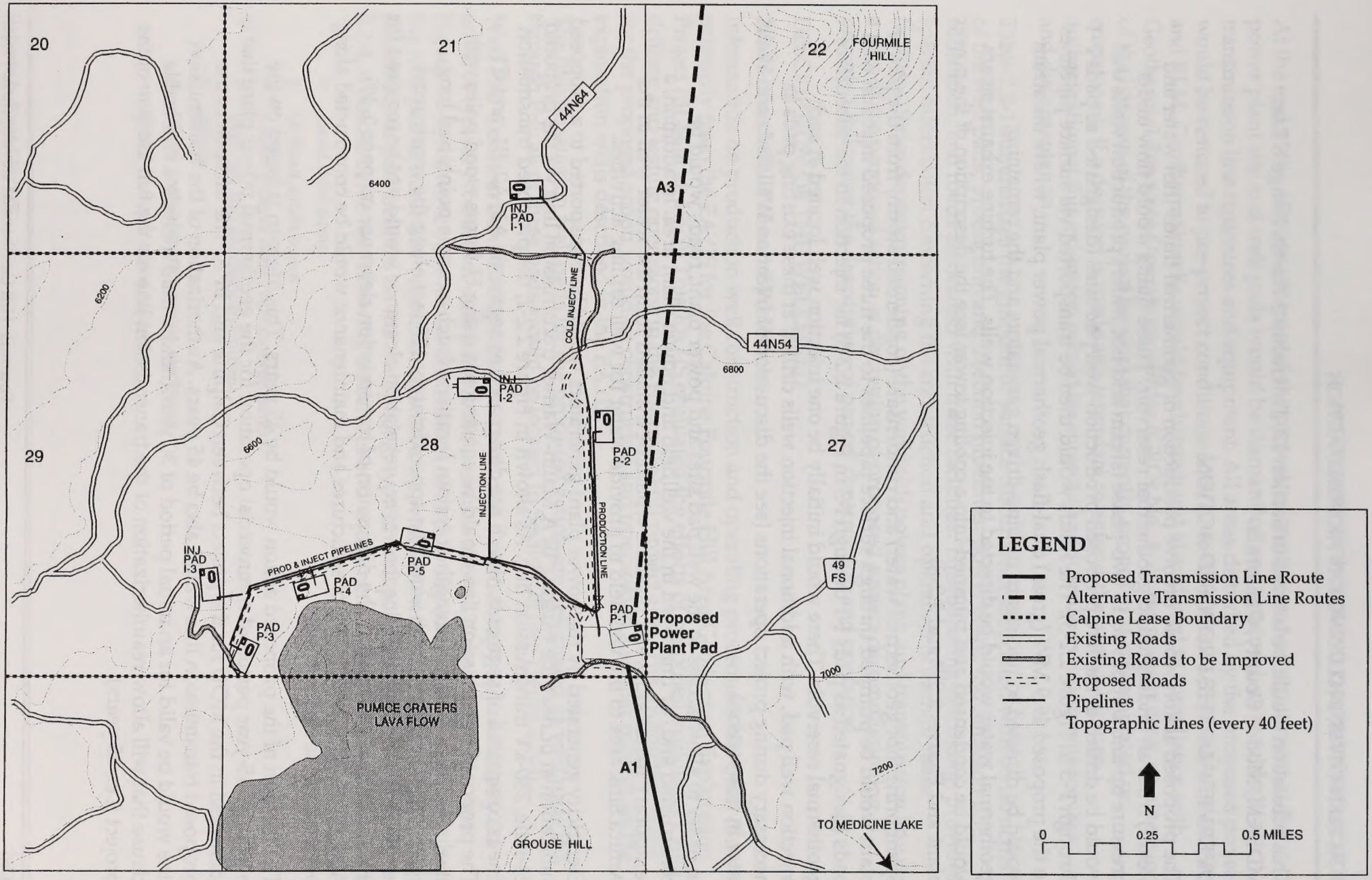


Figure 2.2-3: Power Plant and Wellfield Area



MHA *Environmental Consulting, Inc.*

SOURCE: Calpine

This substation would be located in Section 12, Township 3 North, Range 6 East, MDB&M, Modoc County, California.

OVERVIEW OF THE PROPOSED ACTION

The proposed action would involve production of geothermal fluids (hot water and steam) from an underground geothermal reservoir. These fluids would flow under pressure up and out of 9 to 11 two-phase (steam and hot water) production wells that would be drilled at the five proposed production well pad sites (designated as pads P-1 through P-5 in Figure 2.2-3). The fluids would then be transported via surface pipelines to the proposed 49.9 MW (gross) dual-flash geothermal power plant, where the steam would be directed to two steam turbine-driven generators and the remaining geothermal water would be directed to the injection wells. The turbine exhaust steam would be condensed and pumped into a cooling tower (see the description of the power plant and Figures 2.2-7 and 2.2-8).

Spent brine (hot geothermal water) and condensate (condensed steam) from the power plant would be pumped through surface pipelines to the three proposed injection well pads (designated as pads I-1 through I-3 in Figure 2.2-3) for injection to the subsurface geothermal reservoir. There would initially be one injection well located at each injection well pad, with additional injection wells drilled at these existing pads as necessary during project operations (see the discussion of Injection Well Pads and Wells later in this section).

In order to allow access to the well pad sites and power plant, roads would be constructed and/or improved in the wellfield and power plant area. In addition, a temporary hand-laid water pipeline would be installed from the water well in the Arnica Sink area to the wellfield to provide water for well drilling activities.

Electricity generated by the power plant generators would be transported to a proposed substation at or near the existing BPA Malin-Warner transmission line via the proposed 24-mile, 230-kV transmission line. As shown in Figure 2.2-2, the proposed transmission line is comprised of segments, which are designated as segments A1, A2, B1, and C1. The proposed transmission line would be constructed using H-frame wood poles with steel structures used for strength at certain locations (such as angle points and long spans). Right-of-way width would be approximately 125 feet along the constructed length of the transmission line; however, vegetation clearance would not be required for the entire right-of-way (see the discussion of transmission clearance on page 2-40). Access roads for installation of structures and maintenance would be constructed along portions of the right-of-way.

The lifespan of the proposed action would be 45 years. This lifespan is based on the proposed 45-year period of commercial operation for the geothermal power plant that is identified in the MOU for the project between Calpine and BPA. The lifespan of the proposed transmission line would also be 45 years. Authorization of the transmission line would be valid for an initial period of 30 years, and would include a renewable clause that will allow reauthorization of the transmission line for the full lifespan of the project (i.e., 45 years).

At the end of the 45-year lifespan of the project, all structures and equipment at the power plant site and well pads would be dismantled and removed, as would all transmission line structures and equipment. All areas disturbed by the proposed project would be restored to pre-project conditions and/or to conditions acceptable to the USFS and BLM. Geothermal wells would be plugged and abandoned in compliance with Geothermal Resource Operational Order (GRO) No. 3. At the present time, no extension of the lifespan of the project beyond that currently proposed is contemplated or envisioned. If a decision is made at a later date to extend the project lifespan, authorization of this extension would be subject to additional environmental review and documentation.

Table 2.2-1 summarizes the amount of surface disturbance associated with construction of the well pads, production and injection pipelines, power plant, transmission line, substation, and roads associated with these facilities. The following discussion provides specific information concerning the construction and operation of each of these facilities. Since decommissioning of the wellfield, power plant, and transmission line is a part of the proposed action, a discussion of proposed project decommissioning is provided following the description of project construction and operation.

DESCRIPTION OF THE WELLFIELD

Production Well Pads and Wells

Information on production well construction and operating procedures has been drawn primarily from the EA/IS for the Calpine Fourmile Hill Area Geothermal Exploration Project (BLM et al. 1995). This EA/IS evaluated the effects of proposed exploratory well drilling and testing operations in the Fourmile Hill project area. The production wells for the proposed action would be constructed and operated in a similar manner as the exploration wells described in the EA/IS.

The five production well pads for the proposed action are designated as well pads P-1 through P-5; all of these pads would be located in Section 28 (see Figure 2.2-3).

Well Pad Construction: Each production well pad would occupy approximately 2.5 acres. A typical production well pad would measure about 330 feet by 330 feet (see Figure 2.2-4); however, the actual dimensions of each well pad would be based on siting the well pad to minimize vegetation disturbance while allowing for adequate space for placement of pad facilities on the well pad. A typical well pad, as illustrated in Figure 2.2-4, would include the following structures and equipment during drilling operations:

- Lined fluid sump
- Unlined solids sump
- Above-ground diesel fuel storage tanks
- Drill rigs and ancillary equipment
- Pumps
- Diesel generators to provide electricity
- Office and operations trailers

Table 2.2-1: Surface Disturbance Associated with the Proposed Action

Project Facility/Element	Length (miles)	Construction Path Width (feet)	Area of Disturbance (acres)
WELLFIELD AND POWER PLANT AREA			
Well Pads			
Four production well pads (2.5 acres each)[1]	—	—	10.0
Three injection well pads (2.5 acres each)	—	—	7.5
Power Plant (including the plant site, one production well pad, and a 50-foot firebreak)	—	—	10.4
Pipelines/Roads			
Road/pipeline corridors for production and injection lines with adjacent new roads	1.5	40	7.3
Pipeline corridors for hot injection lines that do not follow roads	0.6	30	2.2
Pipeline corridors for cold injection lines that do not follow roads	1.25	20	3.0
New road corridors not associated with pipelines	0.5	30	1.8
Existing roads to be improved	1.25	30	4.5
Water line from Arnica Sink	4.9	5	3.0
Subtotal			**49.7**
TRANSMISSION LINE			
Right-of-Way Clearance[2]			
Removal			43.0
Removal-conversion			136.0
Disturbance			65.6
Access Roads			
Removal			81.6
Disturbance			9.6
Subtotal			**335.8**
SUBSTATION	—	—	3.0
Subtotal			**3.0**
TOTAL			**388.5**

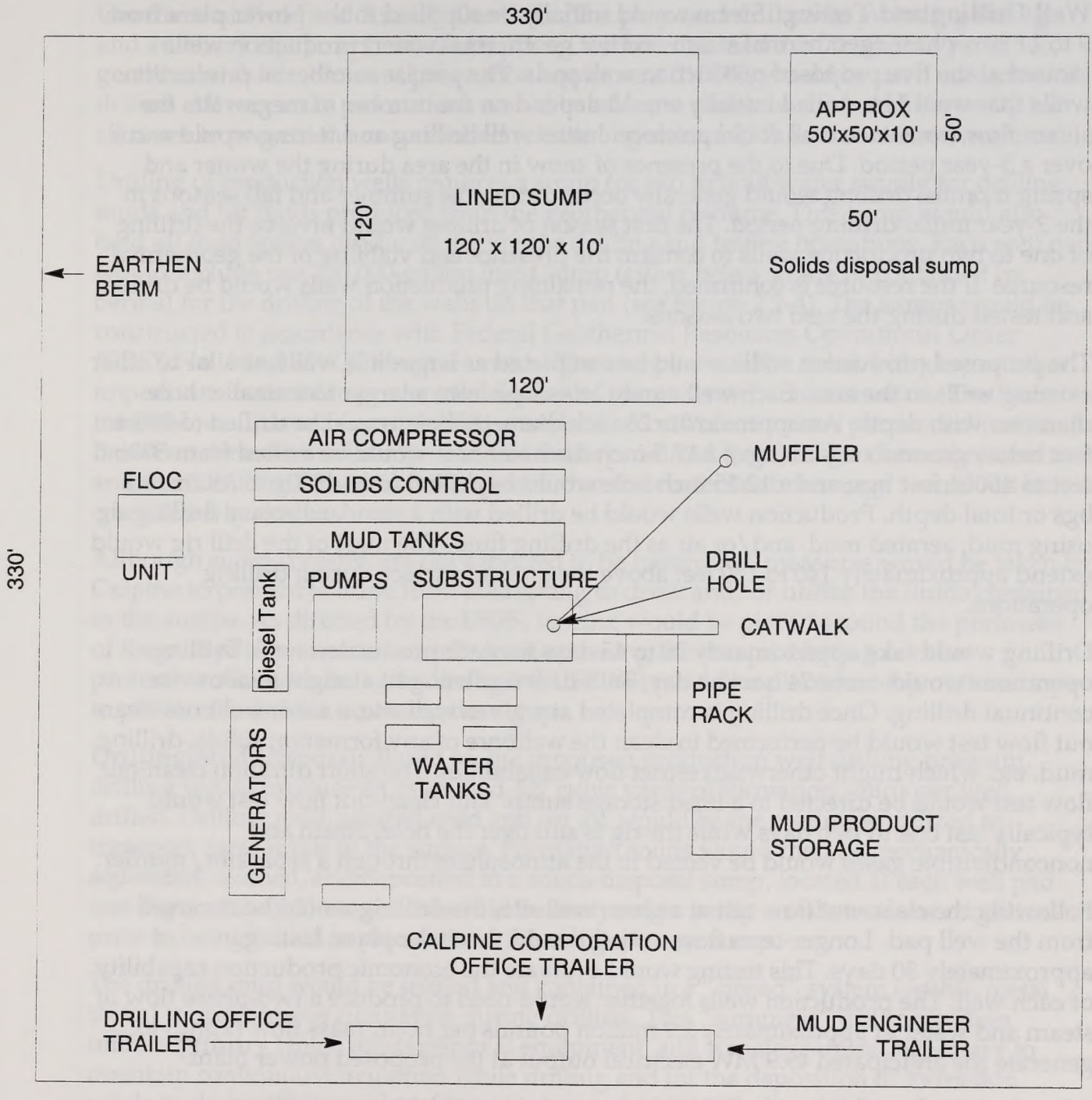
Notes:

1 For the purposes of this table, four of the five proposed production well pads are identified as individual well pads, and one of the production well pads is included as part of the power plant since it would be located within the plant site boundaries.

2 The categories of surface disturbance for the transmission line and associated roads are described in the discussion of transmission line construction beginning on page 40.

SOURCE: G.E. Raleigh and Associates 1997; MHA Environmental Consulting, Inc. 1997

Figure 2.2-4: Typical Well Pad Layout



Construction of each production well pad would begin by removing vegetation and debris from the pad site, as well as grading to level the pad for placement of the drill rig. The surface of the pad site would be compacted once leveling and grading operating equipment would be surrounded by an earthen berm to contain accidental leaks or spills (as shown in Figure 2.2-4).

Well Drilling and Testing: Steam would initially be supplied to the power plant from 9 to 11 two-phase (geothermal steam and hot geothermal water) production wells located at the five proposed production well pads. The precise number of production wells that would be drilled initially would depend on the number of megawatts the steam flow from each well could produce. Initial well drilling and testing would occur over a 3-year period. Due to the presence of snow in the area during the winter and spring months, drilling would generally occur during the summer and fall seasons in the 3-year initial drilling period. The first season of drilling would involve the drilling of one to two production wells to confirm the presence and viability of the geothermal resource. If the resource is confirmed, the remaining production wells would be drilled and tested during the next two seasons.

The proposed production wells would be completed as large-hole wells, similar to other existing wells in the area. Each well would telescope from a larger to a smaller hole diameter with depth. An approximate 26-inch diameter hole would be drilled to 500 ± feet below ground surface (bgs); a 17.5-inch diameter hole would be drilled from 500± feet to 4500± feet bgs; and a 12.25-inch hole would be drilled from 4500± to 8500± feet bgs or total depth. Production wells would be drilled with a standard rotary drilling rig using mud, aerated mud, and/or air as the drilling fluid. The mast of the drill rig would extend approximately 140 to 150 feet above the ground surface during drilling operations.

Drilling would take approximately 30 to 45 days for each production well. Drilling operations would occur 24 hours a day, with drill rigs being lit at night to allow for continual drilling. Once drilling is completed at a given well site, a short wellbore clean-out flow test would be performed to clean the wellbore of any formation solids, drilling mud, etc. which might otherwise restrict flow capabilities. The short duration clean-out flow test would be directed to a lined storage sump. This clean-out flow test would typically last one to two days while the rig is still over the hole. Steam and noncondensible gases would be vented to the atmosphere through a separator/muffler.

Following the clean-out flow test at a given well site, the drill rig would be removed from the well pad. Longer-term flow testing would then take place, lasting approximately 30 days. This testing would evaluate the economic production capability of each well. The production wells together would need to produce a two-phase flow of steam and water at approximately 2.9 million pounds per hour, mass flow (kph_m) to generate the anticipated 49.9 MW electrical output at the proposed power plant.

After the initial production well drilling program is completed, one infill or rehabilitation well would be drilled approximately every two years. Infill production well drilling is usually required for geothermal operations in order to provide a continued source of geothermal fluids at the necessary pressures. Over time, production wells tend to become less productive, and infill drilling is needed to allow for the

continued efficient operation of the plant. Infill well drilling would occur at the existing cleared well pads, and would not require any additional surface disturbance. Infill wells may be drilled from within existing wells (referred to as a "twinned well"), depending on the angle and depth of the desired drilling target, or additional wells may be completed from each well pad.

Geothermal Fluid and Runoff Controls: The proposed drill pads, including the rig and auxiliary equipment, would be placed within a bermed area to control runoff of geothermal fluids. Blowout prevention equipment (BOPE) would be used on each well drilled. All necessary precautions would be taken to maintain control of the well(s) at all times to prevent the uncontrolled release of geothermal fluid into the environment.

Drilling of production wells requires a sump (or pit) to hold water supply for drilling muds and for fluids produced from the geothermal resource. This sump would also hold all fluid wastes produced during the drilling and testing operations. Each well pad would include one 750,000-gallon lined sump (either below grade or contained by berms) for the drilling of the wells on that pad (see Figure 2.2-4). The sumps would be constructed in accordance with Federal Geothermal Resources Operational Order (GRO) No. 4 and RWQCB requirements. The sumps would be lined with clay or other impervious material to prevent fluid loss and groundwater contamination. The liner material would meet a permeability standard of $1x10^{-6}$ centimeters per second (cm/sec). Based on the estimated composition of fluids produced from the geothermal resource and from drilling activities, it is expected that the contents of the sump would not be considered hazardous.

Although sump contents are not expected to be hazardous, measures would be taken by Calpine to prevent wildlife from attempting to drink and/or utilize the fluids contained in the sumps. As directed by the USFS, fencing would be placed around the perimeter of the sumps to prevent mammals from accessing the sumps. Netting or other protective measures (as agreed to by the USFWS) would be placed on top of the sumps to prevent birds from accessing the sumps.

Drilling Mud Disposal: Based on the proposed production well drilling program, drilling would produce an estimated 437 cubic yards of formation solids per well drilled. Drilling mud, aerated mud and/or air would be the mediums utilized to transport these solids to the surface. Formation solids would then be mechanically separated, washed, and deposited in a solids disposal sump, located at each well pad (see Figure 2.2-4). These solids would be analyzed to verify non-hazardous condition prior to being buried in place within the solids storage sump.

The drilling mud would be treated and contained in a "closed" system (within metal tanks) for continuous circulation during drilling. This "sumpless" drilling system utilizes primary tanks, solids removal equipment, and transfer pumps, necessary to maintain continuous circulation while drilling and for the deposition of formation solids in designated areas. Auxiliary tanks would be utilized to collect any extraneous rig runoff and cuttings wash water. Excess cement slurry, generated during cementing jobs, would be directed to a separate metal waste tank where it would be chemically retarded for removal to the solids disposal sump.

Once drilling is completed, all drilling mud would then be treated for dry solids separation and de-watering. The separated "washed" solids (drill cuttings) would also be placed in the solids disposal sump and analyzed to verify non-hazardous condition, and then buried in place. The liquid would be stored in the lined sump for later injection into the geothermal reservoir. If sumps approach capacity, fluids would be piped to another sump or injection well, or drilling or testing would be suspended until sump capacity became available. Three vertical feet of each sump's capacity (approximately 225,000 gallons) would be kept empty at all times in order to accommodate contingency or abnormal conditions. This measure would ensure that ample storage capacity for liquids would be provided to account for emergency conditions.

Groundwater Protection: All drilling and completion operations would be in compliance with the Federal GROs and stipulations of Federal and state permits. Groundwater that may be encountered during well drilling operations would be protected from commingling with deeper geothermal fluids by an approved casing and cementing program in accordance with GRO No. 2 (see Figure 2.2-4a). A Geothermal Drilling Permit approved by the BLM would be obtained for the geothermal wells.

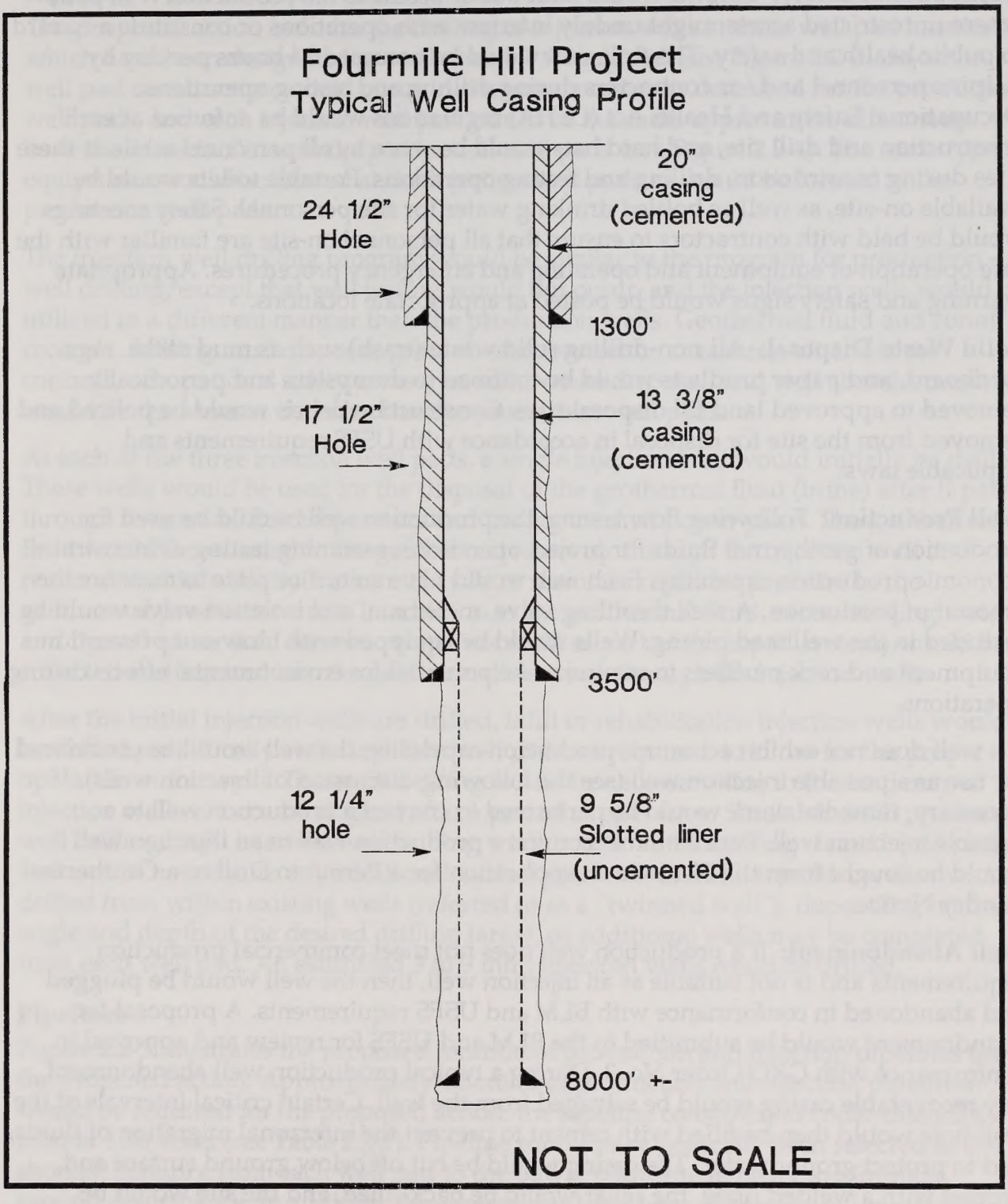
Production wells would have perforated casing in the geothermal reservoir zone to allow geothermal fluids to enter the well. All drilling and casing programs would have prior approval of the BLM, to ensure adherence to GRO Orders and adequate safety margins. The use of downhole production equipment (such as pumps) is not planned, as the geothermal fluids are expected to flash to steam in the well bore and naturally flow to the surface.

Air Emissions Controls: Calpine would implement necessary air emission controls during production well drilling and well testing operations to protect air quality in the area. All well drilling equipment would be equipped with air emission controls, and site watering would be conducted to minimize dust generation and particulate emissions. Monitoring devices, as required by the Siskiyou County APCD, would be installed and operated during drilling and testing. If it becomes apparent during drilling operations that air emissions abatement procedures would be required during long-term testing, Calpine would develop an abatement plan in conjunction with the Siskiyou County APCD for use during the long-term well testing phase.

During drilling operations, flow line gases such as carbon dioxide (CO_2), ammonia (NH_3) and hydrogen sulfide (H_2S) would be monitored by the mud logging personnel. Although H_2S gas may be entrained in the drilling mud and returned with the drill cuttings to the solid separation process, any H_2S gas is expected to be neutralized by the high pH of the mud system. Devices for the continuous monitoring of H_2S gas emissions during drilling and testing operations would be installed on the drill rig floor and solids separation working area. All return fluids would be monitored by the mud logger and safety alarms would be automatically initiated if concentrations exceed worker safety limits.

If air drilling is used during production well drilling operations, particulate emissions would be minimized by the use of water mist injection into the drilling string and/or flow line (blooie line) and the use of a cyclone separator/muffler. Non-condensable and

Figure 2.2-4a: Typical Well Casting Profile



H_2S gases, which are typically encountered during the production zone drilling phase, would be controlled by properly weighted mud which should keep the well from flowing while drilling.

Occupational Safety: Calpine would limit public access to the production well pads where unrestricted access might unduly interfere with operations or constitute a hazard to public health and safety. The drill sites would be occupied 24 hours per day by Calpine personnel and/or contractors during drilling and testing operations. Occupational Safety and Health Act (OSHA) regulations would be enforced at each construction and drill site, and hard hats would be worn by all personnel while at these sites during construction, drilling and testing operations. Portable toilets would be available on-site, as well as bottled drinking water for site personnel. Safety meetings would be held with contractors to ensure that all personnel on-site are familiar with the safe operation of equipment and operating and emergency procedures. Appropriate warning and safety signs would be posted at appropriate locations.

Solid Waste Disposal: All non-drilling solid waste (trash) such as mud sacks, rags, cardboard, and paper products would be confined to dumpsters and periodically removed to approved land fill disposal sites. Construction debris would be policed and removed from the site for disposal in accordance with USFS requirements and applicable laws.

Well Production: Following flow testing, the production wells would be used for production of geothermal fluids for project operations, assuming testing demonstrates economic production capability. Each well would have an orifice plate to measure the amount of production. A well throttling valve, meter run, and isolation valve would be included in the wellhead piping. Wells would be equipped with blow-out prevention equipment and rock mufflers to minimize the potential for environmental effects during operations.

If a well does not exhibit economic production capability, the well would be considered for use as a possible injection well (see the following discussion of injection wells). If necessary, remedial work would be performed to convert a production well to a suitable injection well. Permission to convert a production well to an injection well would be sought from the BLM via an application for a Permit to Drill or a Geothermal Sundry Notice.

Well Abandonment: If a production well does not meet commercial production requirements and is not suitable as an injection well, then the well would be plugged and abandoned in conformance with BLM and USFS requirements. A proposal for abandonment would be submitted to the BLM and USFS for review and approval in conformance with GRO Order No. 3. During a typical production well abandonment, any recoverable casing would be salvaged from the well. Certain critical intervals of the well hole would then be filled with cement to prevent the interzonal migration of fluids, and to protect groundwater. The casing would be cut off below ground surface and capped with a welded plate, the cellar would be back-filled, and the site would be restored to USFS specifications.

The BLM would require Calpine to post bonds covering the costs of plugging the wells and restoring the site. The bonds would be established prior to any construction activities, and would be a condition of approval for the proposed action.

Injection Well Pads and Wells

The proposed action includes the drilling of injection wells at three well pad locations, which have been designated as well pads I-1 through I-3 (see Figure 2.2-3). Injection well pad construction would occur in the same manner as described for the production well pads, and each injection well pad would be the same approximate dimensions and have the same facilities as the production well pads (see Figure 2.2-4). The same type of equipment would be located at the injection well pads as would be located at the production well pads.

The injection well drilling program would be similar to the program for production well drilling, except that well testing would not occur, and the injection wells would be utilized in a different manner than the production wells. Geothermal fluid and runoff controls, drilling mud disposal, groundwater protection measures, air emission controls, occupational safety measures, solid waste disposal, and well abandonment would be the same as described for the production well pads.

At each of the three injection well pads, a single injection well would initially be drilled. These wells would be used for the disposal of the geothermal fluid (brine) after it passes through the steam/fluid separators and the geothermal power plant. The geothermal fluid would be returned to the geothermal reservoir through the injection well and reintroduced into the hydrothermal cycle to maintain reservoir pressure in the geothermal production zone. In addition to the geothermal fluid, excess cooling water and "gray" water (i.e., domestic water not used as part of the septic system) would be collected and injected into the geothermal reservoir through the injection wells.

After the initial injection wells are drilled, infill or rehabilitation injection wells would be drilled periodically at the injection well pads, as required, to allow for the proper operation of the wells. This infill drilling would be necessary due to the tendency of injection wells to become clogged after a period of operation. Similar to infill production well drilling, infill injection well drilling would occur at the existing cleared well pads, and would not require any additional surface disturbance. Infill injection wells may be drilled from within existing wells (referred to as a "twinned well"), depending on the angle and depth of the desired drilling target, or additional wells may be completed from each well pad. An estimated 3 to 9 infill injection wells could be drilled.

Pipelines

Figure 2.2-3 illustrates the proposed location of production and injection pipelines for the proposed action. Approximately 4.5 miles of production and injection pipelines would be required for the proposed action; the pipeline construction could disturb a total of 13.0 acres (see Table 2.2-1). Pipeline routes have generally been selected as the shortest distance from each well pad to the power plant site in order to minimize ground disturbance. In addition, pipeline routes have been aligned to follow existing and proposed road alignments wherever possible for ease of future maintenance. However, the layout of the pipeline system was somewhat dictated by the terrain of the area, and it was not always possible to align the pipelines along roads.

Production Pipelines: The production pipelines would pipe the two-phase geothermal fluid obtained from the production wells to high- and low-pressure centrifugal separators located at the power plant site (the separators would separate the two-phase fluid into steam and liquid), and to pipe the separated steam from the separators to the power plant. The production pipelines would be constructed of insulated carbon steel, and would be used to pipe two-phase geothermal fluid. Heat loss would be reduced by insulating lines with fiberglass blanketing and an aluminum outer cover. The production lines would vary in size from 10-inch-diameter lines at the well to 36-inch-diameter lines for main trunk lines close to the plant. The two-phase pipelines have been sized via a two-phase pressure drop analysis for geothermal piping systems. All production pipelines would be designed, fabricated, and inspected in accordance with the latest version of ANSI code B311 for power piping.

Production pipelines would be placed on above-ground supports and elevated to an average of four feet above ground surface in an attempt to maintain a profile above expected snow levels. The support system would be sufficient for the highest expected snowfall. The production pipelines and supports have also been designed to accommodate thermal expansion and contraction that would occur in the production pipelines as they are heated and cooled. Over a 400°F temperature range, up to 14 feet of expansion can occur in one mile of production pipeline. The production pipelines have been designed to accommodate this amount of thermal expansion and contraction. Approximately 1.5 miles of production pipeline would be required for the proposed action. As discussed above, production pipelines would generally follow the shortest distance from the production wells to the power plant site, which would minimize heat and friction loss.

The proposed production pipelines would follow proposed roads in the wellfield area (see Figure 2.2-3), where possible. A construction path width for the pipelines and roads of about 40 feet would be required. These areas would be graded and cleared of combustible ground cover prior to pipeline installation to avoid fire hazards from welding during construction and maintenance activities.

Injection Pipelines: Two types of injection pipeline would be used for the proposed project: hot injection lines and cold injection lines. The hot injection lines would carry hot injection liquid from the separators to the injection wells. These pipelines would connect the proposed power plant to the proposed injection wells, and allow for the disposal of geothermal fluids (as well as excess cooling water and "gray" water) from the power plant. The injection lines would also carry liquid separated by the high- and low-pressure centrifugal separators.

The hot injection pipelines would be constructed of 12-inch diameter carbon steel. The cold injection lines would carry aerated fluids from the power plant to the injection wells. These pipelines would be constructed of 12-inch diameter High Density Polyethylene (HDPE). At the cold injection line crossing of Forest Route 44N54 (see Figure 2.2-3), this line would be placed in conduit that would pass under the road.

In addition to production pipelines, the proposed action would require approximately 3.4 miles of injection pipelines (see Figure 2.2-3). Approximately 1.5 miles of proposed injection pipeline would follow existing or proposed roads. These pipelines would be

located in the 40-foot-wide construction corridor described for the production pipelines that are adjacent to roads. The remaining 1.9 miles of proposed injection pipeline would not be located adjacent to roads, and would require a construction corridor specific to the pipeline. About 0.6 miles of this type of pipeline would be hot injection lines, and approximately 1.3 miles would be cold injection lines. Hot injection lines would require a 30-foot-wide construction path, and cold injection lines would require a 20-foot-wide construction path. These areas would be graded and cleared of combustible ground cover prior to pipeline installation.

Roads and Access

Road Construction: A total of approximately 2.0 miles of new roads would be constructed in the wellfield area (see Figure 2.2-3). The new roads would provide access to proposed well pads, as well as access for maintenance of proposed production and injection pipelines. About 1.5 miles of new roads would be located within the 40-foot-wide construction corridor described for the production and injection pipelines that are adjacent to roads. The remaining 0.5 miles of new roads would not be located along pipelines, and would require a 30-foot-wide construction path.

All proposed new roads in the wellfield area would be designed and constructed with good engineering practices in accordance with USFS specifications for roads in Chapter 4 of the USFS Road Preconstruction Handbook (USFS 1987). Proposed new roads would be similar in design to existing paved roads throughout the Klamath and Modoc National Forests. These roads would be built as single-lane resource roads, and would be approximately 20 feet wide. Turnouts would be provided at intermittent locations along the roads to allow vehicles heading in opposite directions to pass each other. At these locations, the maximum width of the roadway would be 25 feet. The construction corridors for the new roads would be cleared of vegetation and graded, and the roadbeds would then be surfaced with macadam pavement. This type of pavement is an asphalt-like road surface that would be created by the application of thick oil (and possibly gravel) to the dirt roadway surface, with subsequent compaction from vehicle travel.

The proposed action would also involve improvements to approximately 1.25 miles of existing roads. These improvements would generally involve widening the roadways where necessary to 14 feet, and surfacing of the roadways with macadam pavement. Similar to the construction of new roads, the improvements to existing roads would require an estimated 30-foot-wide construction path to account for drainage ditches and cut and fill slopes along the sides of the roads.

Access: The two primary access routes to the wellfield area (and the power plant) are Forest Road 97 to Forest Road 49 (which approaches the wellfield from the east), and Forest Road 15 to 44N01 to 44N64 (which approaches the wellfield from the west) (see Figure 2.2-2). Access for construction vehicles needed to construct the wellfield and power plant would be limited to Forest Road 15, 44N01, and 44N64. The USFS has enacted this limitation in order to prevent conflicts in the summer months with recreational uses at Medicine Lake, and in the winter months with snowmobiling activities in the area.

During the summer months, employees of the project and commercial traffic could use either Forest Roads 97/49 or Forest Road 15/44N01/44N64 to access the wellfield and power plant areas. During the winter months, employee and commercial traffic access would be limited to Forest Road 15/44N01/44N64; Forest Roads 97/49 would not be kept open in the Medicine Lake area, and this route would not be used in the winter months to access the wellfield and power plant areas.

During the winter months, Forest Road 15 from the boundary of the Klamath National Forest to the Four Corners Snowmobile Park (see Figure 2.2-2 for the location of this park) is currently kept open by the USFS, which performs snow blowing and removal along this road as necessary during the winter. Along 44N01 and 44N64 from the snowmobile park to the wellfield, Calpine proposes to conduct snow blowing and removal as necessary in order to keep this road open in the winter. In addition, a carpool area would be established near the snowmobile park and a Calpine 4-wheel drive vehicle would be available to transport employees to and from the wellfield during winter months. A sno-cat would also be available to transport employees between the carpool area and the wellfield during snow events and when access is snow-bound.

Water Requirements and Supply

Water usage during a typical well drilling operation of an 8,500-foot well would be approximately 20,000 gallons per day over a 30- to 45-day drilling period. This water usage equates to approximately 800,000 gallons to drill one well.

In order to supply drilling water during the first season of well drilling, a temporary hand-placed surface water pipeline would be installed from the existing USFS groundwater well in the Arnica Sink area to the wellfield area (see Figure 2.2-2). This pipeline would generally parallel Forest Road 49 on the north and east side to the intersection with the access road to the plant development and wellfield. The freshwater pipeline would be buried to cross beneath this portion of Forest Road 49, and would surface and parallel the access road on the north and east side to the wellfield. The pipeline would terminate at a vertical stand pipe in the wellfield, where water trucks would be filled with water to be transported to the various well drilling sites. It is anticipated that a diesel-powered booster pump would be installed at an appropriate location within the pipeline to provide sufficient water pressure to deliver the water to the wellfield.

Prior to installation of the temporary water pipeline, the precise route for the pipeline would be field reviewed with USFS personnel to obtain USFS concurrence on the route, and the route would be staked and flagged. The temporary water pipeline would then be laid by hand, and it is expected that the 4-inch-diameter aluminum pipeline segments would be hand-carried to the pipeline route from a trailer along the adjacent road. The segments would be joined using appropriate hand tools, and the pipeline would be routed around trees, large rocks, and other surface obstacles. Neither vegetation clearance nor grading would be required within the pipeline route; however, installation could affect a corridor up to approximately 5 feet wide.

At the end of the first season of drilling, the temporary freshwater pipeline would be disassembled by hand and removed from the project area. Before the completion of the

first drilling season, a groundwater well would be drilled within the wellfield area. A vertical standpipe would be erected at the groundwater well, and water trucks would be filled from the standpipe with water to be transported to the various well drilling sites. This well would supply water for subsequent drilling activities in the wellfield. The Arnica Sink well would serve as a backup water supply, if needed.

DESCRIPTION OF THE POWER PLANT

The proposed power plant would be a dual-flash geothermal power plant located on a 10.5-acre site in the southeastern corner of Section 28 (see Figures 2.2-2 and 2.2-3). Access routes to the power plant site would be the same as described above for the wellfield area. The power plant site would include various administrative and power-generating facilities and structures, and would be surrounded by a chain-link fence (painted dark green) to prevent unauthorized access. A minimum 50-foot fire break would be established and maintained around the plant site perimeter. Figure 2.2-5 illustrates the proposed layout of the power plant site, and a three-dimensional conceptual rendering of the power plant is shown in Figure 2.2-6. Primary facilities that would be located at the proposed power plant would include:

- Centrifugal separators
- Turbine/generator building (containing turbines, generators, condensers, and control and electrical rooms)
- Cooling tower
- Injection tank and pumps
- 230-kV switchyard
- Air and noise emission control equipment
- Water, waste disposal, and fire protection systems
- Other structures and equipment, including a service/dormitory building, storeroom, workshop, diesel fuel storage tank, and unleaded above ground gas tank

Production well pad P-1 would also be located within the boundaries of the plant site (see the preceding discussion of production well pads and wells for a discussion of proposed equipment, facilities, and activities at this well pad). The following discussion provides a detailed description of the facilities at the proposed power plant. This description is followed by a discussion of proposed plant construction and operation.

Power Plant Site Facilities

Centrifugal Separators: The proposed geothermal power plant would include high- and low-pressure centrifugal separators, which would separate the two-phase geothermal fluid into steam and liquid. The separated steam would be piped to the turbine/generator building at the plant, while the liquid separated from the steam would be pumped directly to the injection wells.

Turbine/Generator Building: The turbines, generators, and condenser for the proposed power plant would be housed in a metal building (referred to as the "turbine/generator building") at the plant site (see Figure 2.2-5). This building would be a maximum height of 94 feet and would be the tallest structure on the plant site (see Figure 2.2-6). Directly connected to the turbine/generator building would be a 230-kV

Figure 2.2-5: Proposed Layout of Power Plant Site

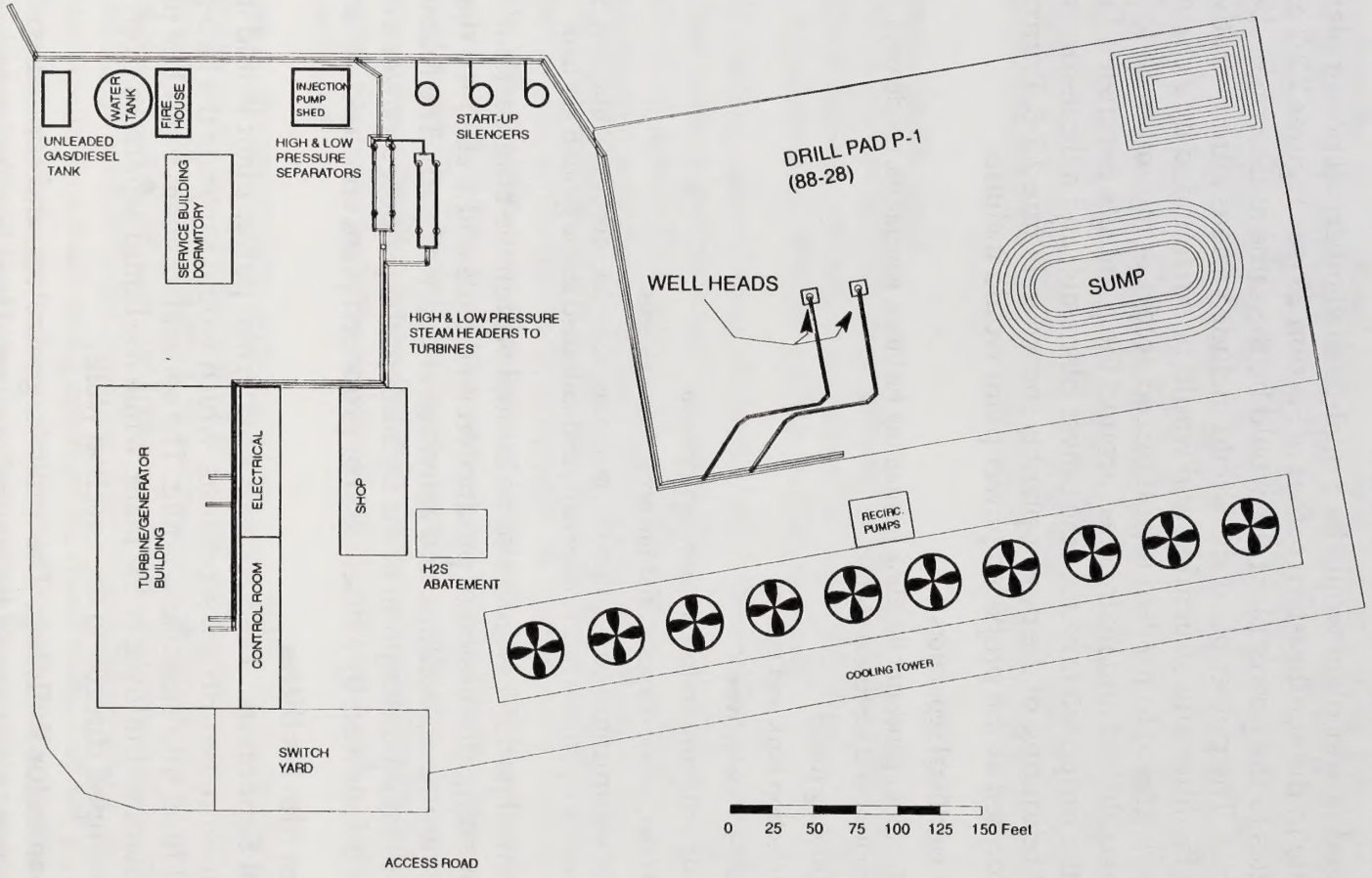
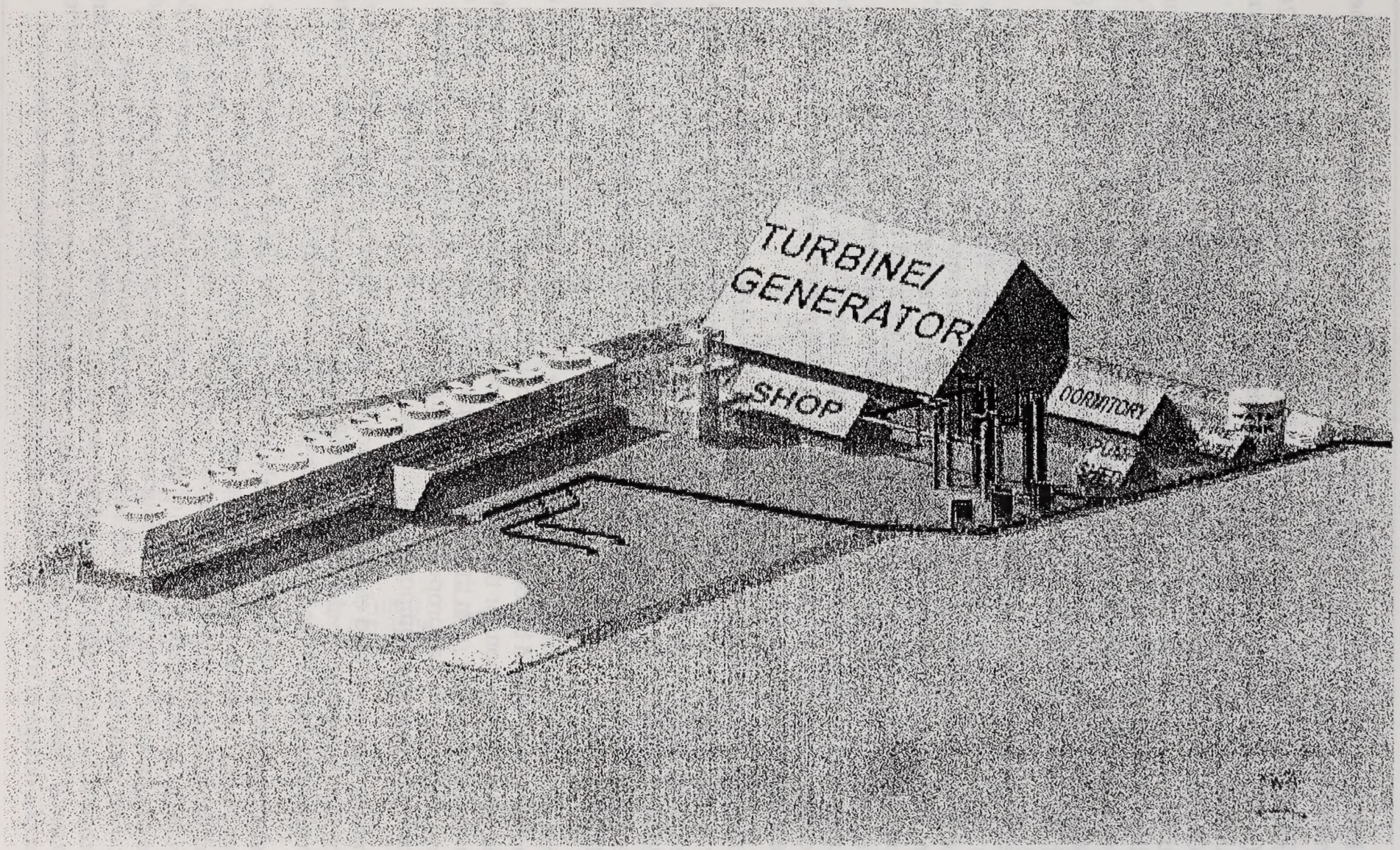


Figure 2.2-6: Three-Dimensional Conceptual Rendering of the Power Plant



MHA *Environmental Consulting, Inc.*

SOURCE: Calpine

switchyard, as well as a control room and an electrical room for the power plant. The following describes each of these proposed facilities.

Turbines: The power plant would include two turbines, each capable of producing 24.9 MW (gross) of electrical power. With both turbines in full operation, the gross electrical output from the plant would be 49.9 MW at a steam delivery rate of approximately 800,000 pounds per hour (lb/hr). Approximately 5.0 MW of this total electricity production would be used by the power plant for all normal plant operations such as running lights, pumps, other plant equipment, and wellfield facilities. The 44.9 MW of net power generation would be delivered via the proposed transmission line to the regional power network; this power generation would be sufficient to provide enough electricity to meet the needs of approximately 45,000 residences.

In the proposed double-flash power plant, the steam produced from the production wells would drive the high-pressure stage of each turbine. The hot water from the wells would be combined in the low-pressure separator, where more of the water flashes to steam. This steam drives the low-pressure stage of the turbine (hence, "double flash"). The turbine is connected to an electric generator, as described below. After passing through the turbine, the spent steam goes to a condenser, located at the exhaust end of the turbine unit, and is condensed to water (steam condensate). Figure 2.2-7 illustrates the actual power plant process flow, and Figure 2.2-8 provides a schematic illustration of the power production process.

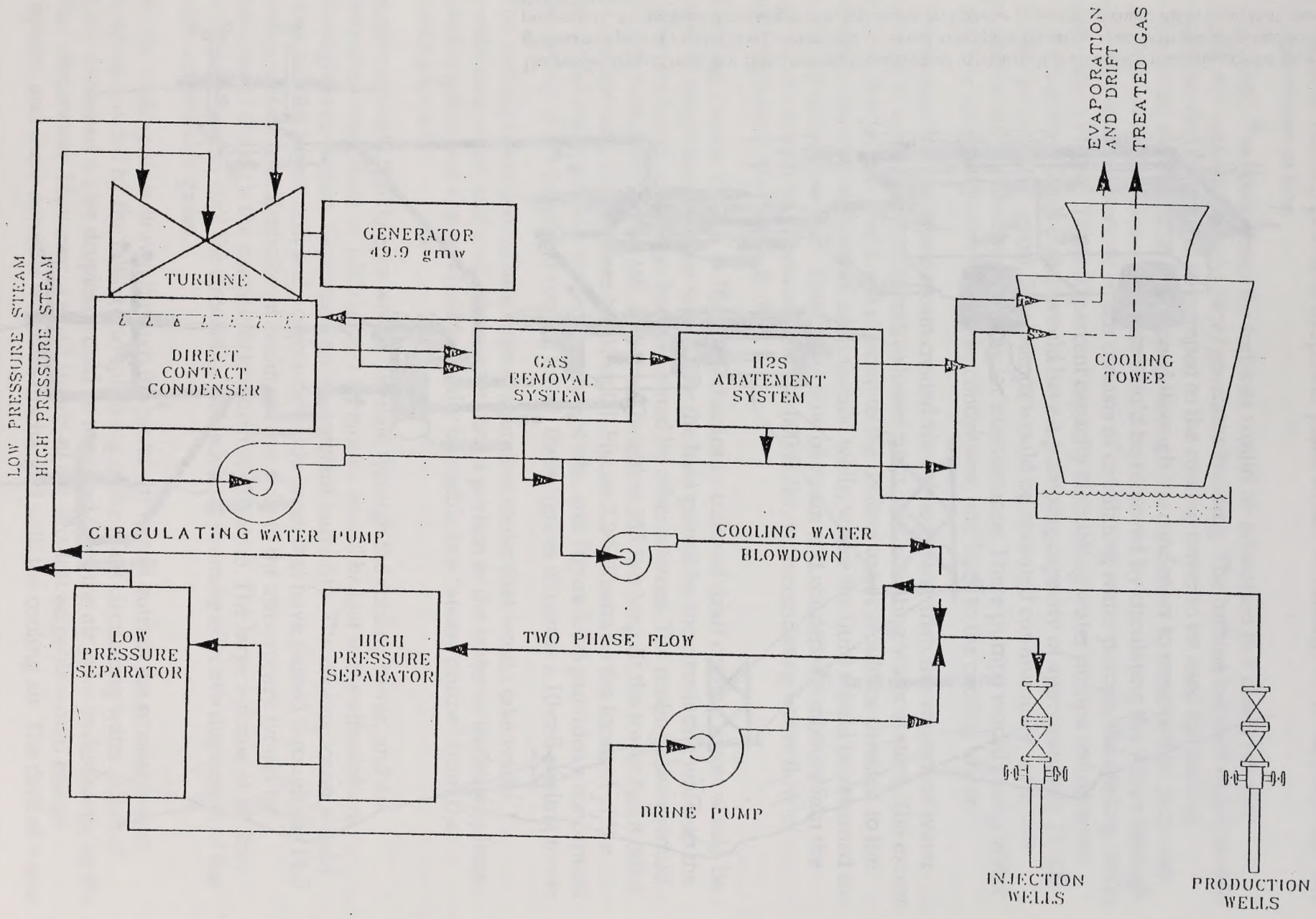
Turbine control and isolation would be provided by electro-hydraulically operated control and stop valves in the main steam line to the turbine. Fluid for the operation of these valves would be taken from the turbine lubricating oil system. Lubricating oil would be supplied to the turbine from a shaft-driven oil pump with AC and DC motor-driven oil pumps as backup. Lubricating oil cooling, purification, and storage facilities would be provided.

Main controls and monitoring equipment for the turbines (as well as other facilities at the power plant) would be located in the control room. These controls would allow power plant staff to monitor the performance and efficiency of plant equipment. For maintenance purposes or in the event of an emergency, plant staff would be able to shut down and/or turn off appropriate equipment and facilities from the control room. Controls for restarting equipment would also be located in the control room.

Generators: The air-cooled electric generators would be directly connected to the turbine shafts. Each generator would operate at 3,600 rpm and would be designed to produce approximately 24.5 MW at 13.8 kV, three-phase, 60 hertz (hz).

The electric generators would be directly connected to the 230-kV switchyard at the power plant. The generators would deliver power to the main 13.8-kV bus at the switchyard through respective generator breakers. The main 13.8-kV bus would provide the approximately 5.0 MW of electrical power to the power plant that would be necessary to operate the plant via four auxiliary transformers. The net power output of the power plant (44.9 MW) would be fed to the main power transformer at the switchyard, which would transform this power for the 230-kV transmission line. An emergency diesel generator would provide power to the power plant critical load in the event of a outage of the 230-kV transmission line and/or a shutdown of the plant

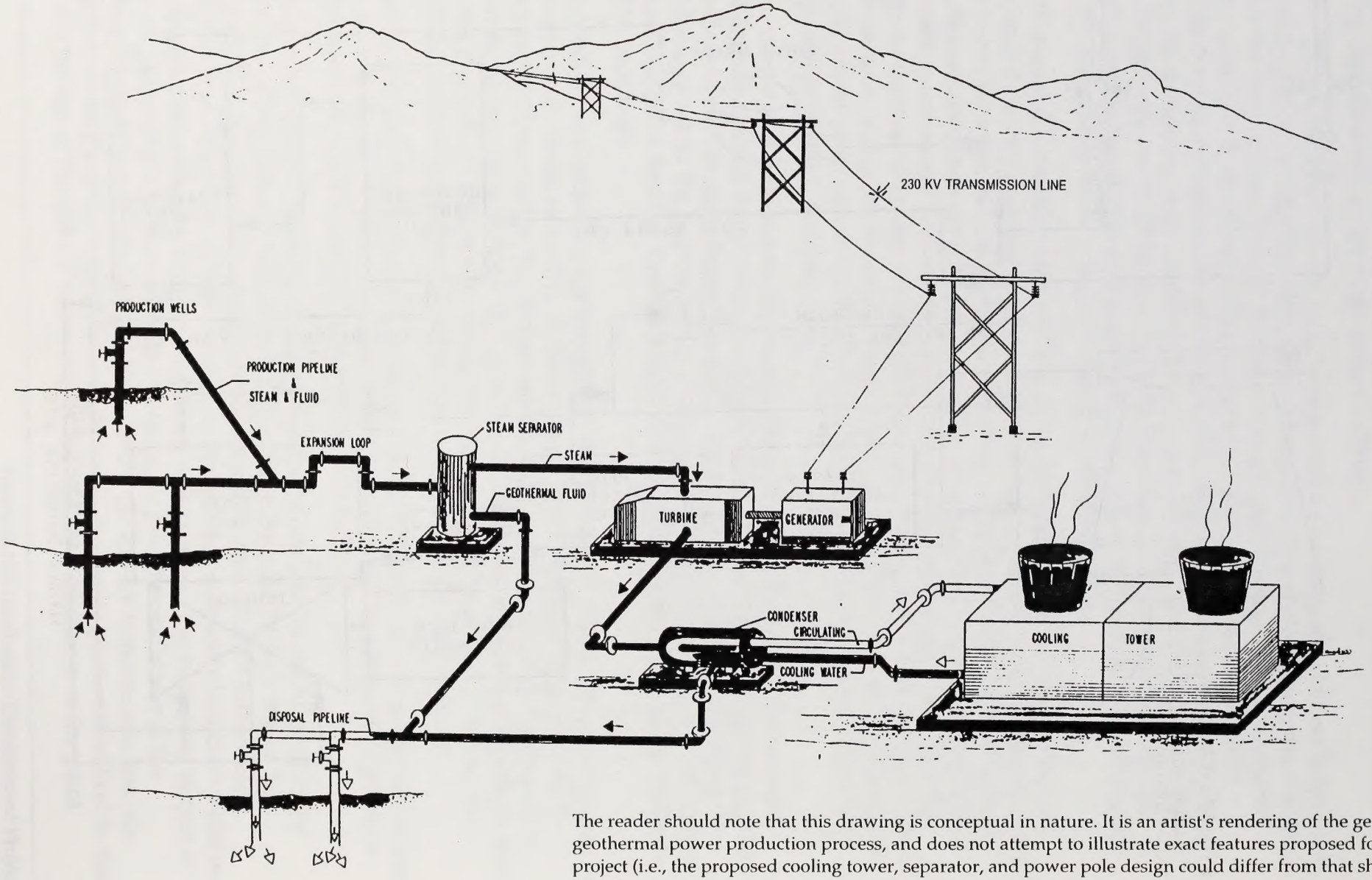
Figure 2.2-7: Actual Power Plant Process Flow



MHA *Environmental Consulting, Inc.*

SOURCE: Calpine

Figure 2.2-8: Schematic Illustration of the Power Production Process



The reader should note that this drawing is conceptual in nature. It is an artist's rendering of the general geothermal power production process, and does not attempt to illustrate exact features proposed for this project (i.e., the proposed cooling tower, separator, and power pole design could differ from that shown in this diagram).

generators. Startup power to the power plant would be backfed from the proposed 230-kV transmission line.

Condenser: The steam from the turbines would be exhausted to a direct-contact condenser located at the turbine/generator building. The turbine exhaust steam would condense into water and be pumped to the cooling tower to be used for cooling. Circulating water would be pumped through the condenser to remove heat from the steam from the turbines. This heat would be removed by circulating the water through a heat dissipation system, which consists of circulating water pumps, the cooling tower, and related piping. Three 50 percent capacity circulating water pumps would serve each condenser. Each pump would have a pumping capacity of approximately 22,500 gallons per minute (gpm). Two pumps would be operated continuously, with one pump serving as a backup to allow for maintenance. These pumps would pump water from the cooling tower through the condensers, and back to the cooling tower.

The amount of condensed steam created would be greater than the amount of water needed to make up for evaporative losses from the circulating water system. The excess flow of condensate that is not directed to the cooling tower would be directed to the injection system for disposal into injection wells, where the fluid would be returned to the geothermal reservoir. Total rated flow of steam and condensate mixture into the condenser would be approximately 815,000 lb/hr, with circulating water flow of approximately 45,000,000 lb/hr.

Cooling Tower: One 8- to 10-cell mechanically-induced draft cooling tower would be used as the primary means to dissipate the heat gained by the circulating water in the main condenser, as well as heat generated by other sources. The cooling tower would be approximately 70 feet tall, and could be either 355 feet long (if the tower has 8 cells) or 443 feet long (if the tower has 10 cells). Figure 2.2-5 illustrates the location of the proposed cooling tower at the power plant site, and Figure 2.2-6 provides a conceptual rendering of the proposed cooling tower; these figures illustrate a 10-cell cooling tower.

The cooling tower would be a large evaporative cooler that would take warm condensate water and cool it by evaporating a portion of the water to the atmosphere. Discharged water vapor would generally be visible as a "steam plume" from the cooling tower.

Approximately 90,000 gpm would circulate through the cooling tower, and an estimated maximum of 1,300 gpm (1.5 percent) would be lost to the atmosphere through evaporation, depending on the ambient humidity. The cooling tower would emit cooling tower drift and non-condensable gases that have passed through the H_2S abatement system. Emission of cooling tower drift to the atmosphere would be minimized through the use of efficient drift eliminators. The large volume of air that would be used to cool the circulating water would promote effective dispersion of the non-condensable gases.

As the cooling air is drawn through the towers, it would entrain the smaller water droplets created by the falling and splashing of the plant circulating water. Most of these entrained water droplets would be removed from the air prior to discharge by the mist eliminators. However, a small faction of the smallest aerosols would escape capture, and these aerosols would be discharged with the cooling air. The drift of water

droplets would contain the same dissolved salts and suspended matter as the circulating water.

The amount of particulate that would be contained in cooling tower emissions is expected to be small. The calculated particulate emission rate is based on the following estimates:

- Circulating water flow (CWF) = 44,836,770 lbs/hr
- Cooling tower drift rate = 0.001 percent of the CWF or 448 lbs/hr
- Cooling tower effluent = 39,700,000 lbs/hr of dry air at 86°F
- Density of cooling tower effluent = 0.07152 lbs/ft^3

Conservatively, if it is assumed that 100 percent of the drift leaving the tower consists of particulates, the emission rate would be about 0.00663 grains per actual cubic foot (gr/ACF). A more realistic analysis of emissions would be to assume that the suspended and dissolved solids in the drift may form particulates. The suspended solids concentration in the drift would be on the order of 100 parts per million. The particulate emission rate from this source would be about 6.6×10^{-7} gr/ACF. The highest instantaneous concentration of total dissolved solids in the drift is estimated to be 1607 parts per million. If all of these solids were assumed to be particulates, the solids emission rate would then be about 1.33×10^{-5} gr/ACF.

The cooling tower drift would contain chloride, sulfates, ammonia, boron, calcium, magnesium, mercury, aluminum, sodium, potassium, arsenic, and iron. Sources of these constituents include the various chemicals in the geothermal steam, sodium hydroxide (which would be used for routine treatment of the circulating water flow), and sodium hypochlorite which would be used occasionally as a biocide for treatment of the circulating water flow to control growth of algae. The presence of algae negatively affects cooling efficiency.

Injection Tank and Pumps: The injection tank and pumps would be housed in a shed located at the northern edge of the proposed power plant site (see Figure 2.2-5). The injection tank would collect excess circulating water from the power plant, as well as sewage system effluent. The injection pumps would pump the contents of the tank to injection wells located at the three proposed injection well pads (see the discussion of injection well pads and wells for information about activities at these well pads).

Air Emission Control Equipment: Air emission controls would be provided at the power plant site primarily for hydrogen sulfide (H_2S) control.

Hydrogen Sulfide Control: The emission of sulfur compounds to the atmosphere is a key concern in the design and operation of geothermal power plants. The greatest concern is H_2S, which is a naturally occurring gas in geothermal systems and has been described as having a rotten egg smell. This gas does not condense to liquid as does the steam, and must be removed chemically and properly disposed. For design criteria purposes, the concentration of H_2S in the production fluid has been assumed to be approximately 60 parts per million by weight (ppm_w), although actual concentrations are expected to be substantially lower due to preliminary estimates of H_2S content in the Glass Mountain KGRA.

The proposed power plant would be designed to control atmospheric emissions of sulfur compounds present in the steam supply and to comply with local, state, and Federal regulations that govern the release to the atmosphere of this and other compounds. These controls would include the use of a direct-contact condenser, removal of non-condensable gases, and use of an H_2S abatement system.

As discussed previously, a direct-contact condenser would be located in the turbine/generator building at the power plant site. This condenser would "partition" or divide the H_2S flow into either a part of the non-condensable gas phase or a part of the steam condensate. With the direct-contact condenser, approximately 50 percent of the H_2S would be contained in the non-condensable gas phase. These gases would require abatement in order to minimize the emission of H_2S.

In the power plant condenser, 30 to 40 percent of the H_2S present dissolved in the steam will be dissolved in the condensate. The remaining 60-70 percent will enter the noncondensible gas treatment system (the primary abatement system), where 95 percent or more will be removed. The secondary abatement system will remove 75 percent or more of the H2S dissolved in the condensate. If the emissions testing and H_2S monitoring systems at the power plant indicate that H_2S in the steam condensate would require abatement, a secondary abatement system would be provided. This system would most likely inject an iron catalyst solution into the circulating water. The process would result in the oxidation of H_2S with O_2 in the liquid phase to produce water and soluble sulfur (disposal of sulfur is discussed later in this section).

Non-condensable gases that would contain H_2S would be removed from the direct-contact condenser by steam jet gas ejectors, a hybrid of vacuum pumps and gas ejectors, and other mechanical means. Further cooling at the exhausts from the ejectors/pumps would condense carry-over steam from the condenser. The remaining non-condensable gas flow would be transferred to the primary H_2S abatement process for removal of H_2S gas.

The primary H_2S abatement system for the proposed action would remove H_2S from the non-condensable gas flow discharged from the non-condensable gas removal system. This system would remove H_2S from the steam as it leaves the gas removal system. Residual gases from the H_2S abatement process would be routed to the cooling tower, where they would be discharged to the atmosphere. Even during startup, shut down, and unscheduled power outages, steam would pass through the primary H_2S abatement system before venting. Two alternative H_2S abatement systems are currently being evaluated by Calpine for use at the power plant: an H_2S burner-scrubber, or the Stretford process. The expected H_2S removal efficiency for these systems is over 98 percent. A final decision on the appropriate H_2S abatement system would be made when well chemistry data are confirmed following the first well drilling season.

Noise Control Equipment: The power plant facilities would include noise abatement measures and equipment to reduce noise emissions during project operation. Steam handling equipment, steam piping, and steam ejector housings would be insulated. Steam discharge to the atmosphere during plant outages would be made through an effective muffling system. A low-noise enclosure for the power plant operators would be provided inside the turbine building. An enclosed building would house the air

compressors and steam jet gas ejector/vacuum pumps, thus reducing the propagation of noise to the outside environment. Excessively noisy ancillary equipment would be muffled as necessary.

Water Systems and Water Use: Condensed geothermal steam (water) would be circulated through the power plant for condensing steam and cooling equipment. Smaller quantities of fresh water would be required for domestic uses and fire protection. The following subsections describe these water uses and associated systems.

Condensing and Cooling Water Requirements: Initial startup of the proposed power plant would require approximately 1 million gallons of fresh water for the cooling system. This water would be supplied primarily from the groundwater well that would be drilled in the wellfield during the first well drilling season (see the discussion of water requirements and supply earlier in this chapter). If necessary, supplemental water from the existing Arnica Sink wells and other outside sources would be trucked into the power plant site to provide the water required for plant startup.

Following initial startup of the power plant, sufficient steam condensate would be available to make up for circulating water losses due to evaporation and drift. No additional water supplies are therefore expected to be required for the cooling water system during plant operations.

Domestic Fresh Water System: Drinking water for plant employees would be supplied by bottled water delivered by truck to the plant site; storage for bottled water would be provided to ensure an adequate supply of bottled water during the winter months if delivery is not possible. Water supply for other domestic uses would be provided by the groundwater well that would be drilled in the wellfield during the first well drilling season. Domestic water demand during construction of the plant is estimated to be as much as 10,000 gallons per day, and would be used primarily for dust suppression. A similar peak demand is expected during maintenance and overhaul of major equipment. This estimate includes an allowance for water required for landscaping.

Fire Protection Systems: Water for the fire protection system would be provided by a 200,000-gallon on-site storage tank. The yard fire protection system would consist of a buried pipe distribution system serving fire hydrants with fully equipped hoses and connections to the power plant to serve interior hose stations and sprinkler systems. One electric-drive and one diesel-drive fire protection booster pump would be installed.

Liquid Waste Disposal: There would be six types of liquid wastes that would be generated by the proposed power plant:

- Geothermal brine
- Excess steam condensate
- "Gray" water (i.e., domestic water not used as part of the septic system)
- Stretford system wastes (if used)
- Oily wastes
- Septic system effluent

As discussed previously, the geothermal brine (brine would be separated from the high- and low-pressure steam in the separators at the plant site), excess circulating water

(condensate), and gray water would be collected in an injection tank for pumping to the geothermal reservoir through the injection wells. If the Stretford system is used for H_2S abatement, the solution from this system would be cycled many times before it must be replaced. It is projected that the solution in the Stretford system would need to be replaced approximately every five years. The spent Stretford solution would be analyzed and disposed of at an approved waste management unit in accordance with current state and Federal regulations and procedures.

Oily wastes would be generated from minor leaks and through routine maintenance procedures. The waste would be collected in oil/water separators, stored on-site, and either disposed of by an approved oil reprocessor or transferred to an approved waste disposal facility. See the following discussion of solid waste disposal for a discussion of the disposal of septic system effluent.

Solid Waste Disposal: Solid waste generated by the proposed power plant would include:

- Inert construction and maintenance materials and wastes
- Solids from the on-site sewage treatment (septic) system
- Sludge from the cooling tower basin
- Byproduct sulfur from the primary H_2S abatement system

Inert wastes produced during construction, maintenance, and operation of the power plant would consist of materials such as excess concrete, scrap lumber, paper, and plastic packaging. These wastes would be hauled to an approved waste management unit and disposed of in accordance with applicable regulations. Although Calpine would attempt to balance soil cut and fill at the power plant site during construction activities, excess soil material may be generated. This material would be disposed of at a USFS-approved spoils disposal site.

Septic tank sludge and effluent would be removed from the treatment facility approximately once per year (during the summer months) by a licensed commercial septic tank pumping service. This sludge and effluent would then be removed from the project area by the pumping service for disposal at an appropriate site.

The cooling tower basin would accumulate approximately 4 to 12 dry tons per year of sludge. This sludge would consist of dirt and particulates removed from the ambient air, and also elemental sulfur and chelated iron compounds (if used) from the secondary H_2S abatement process. Removal of the sludge would be required about every five years. Disposal of the sludge would occur at a USFS-approved off-site location.

Sulfur cake would be formed as a by-product of the Stretford H_2S abatement system, if it is selected as the primary H_2S abatement process. Approximately 240 wet tons per year of sulfur cake would be expected. Commercial use of this sulfur would be evaluated. Wastes would be analyzed by an approved laboratory and disposed of in accordance with local, state, and Federal regulations. The burner-scrubber unit, if selected, would not generate a solid waste by-product.

Fire Protection Systems: All fire protection systems would be designed and installed in accordance with approved fire code and insurance requirements. A fire suppression equipment storage shed (identified as a "fire house" in Figure 2.2-5) would be located in the northwest corner of the proposed plant site. A sprinkler system would be provided in the turbine/generator building and the staff quarters and office building. Electrical and control areas would have cement floors with duct banks, and would be protected by portable fire extinguishers. Interior hose stations would be installed throughout the power plant at appropriate intervals to cover all areas. All fire protection systems would be monitored and operated from the main control room.

The cooling tower structures would be wood structures with fire retardant fill and separators between the cells. An approved fire suppression system would be provided by the cooling tower vendor, or a fire retardant fiberglass tower would be used without a fire suppression system required. All buildings would be provided with water spray systems.

Other Plant Site Structures and Equipment: Other structures located at the power plant site would include a service and dormitory building, a workshop, and a diesel fuel storage tank (see Figure 2.2-5). The service and dormitory building would provide sleeping, living, and eating quarters for up to 19 on-site workers, and would provide storage for worker supplies (such as bottled water, food, and clothing). Electric stoves powered by the power plant would be provided for cooking, and electricity from the power plant would also be used to heat the dormitory and other on-site buildings. Equipment and vehicle repair would take place in the workshop, which would also house chemicals and materials (such as cleaners, oils, and solvents) used in plant maintenance. The diesel fuel storage tank would hold diesel for use in backup generators, as necessary, and an above ground unleaded gasoline storage tank would hold fuel for vehicle usage.

Plant Site Construction Sequence

Construction of the proposed geothermal power plant is expected to take approximately two years. This construction would not begin until after testing of the initial production wells drilled during the first well drilling season confirms the presence and viability of the geothermal resource. Plant construction would therefore not begin until the second season of well drilling, and completion of plant construction would coincide with completion of the initial well drilling and testing program. Proposed power plant construction activities would consist of both plant site preparation and erection of the power plant facilities.

Plant Site Preparation: The principal equipment to be used in the preparation of the plant site would include:

- Bulldozers and tractors
- Dump trucks
- Front-end loaders
- Compaction equipment
- Water trucks

In order to initiate construction of the proposed power plant, the plant site would first be cleared and grubbed as necessary. Felled trees would be cut to commercial lengths and decked for salvage (as appropriate), sold, or hauled away for disposal. Stumpage charges for removal and disposal of tree stumps from the plant site would be paid to the USFS, as required.

The plant site would then be graded with conventional excavation equipment. The site would be designed to balance cut and fill of soils. Cut-and-fill slopes would not exceed a 1.5:1 ratio (horizontal to vertical). Fill areas would be watered and compacted using appropriate construction techniques to meet appropriate geotechnical engineering standards (90 to 95 percent compaction).

The plant site would be gently sloped and bermed to prevent water ponding and to direct runoff. On-site runoff would generally be directed to local topography, and internal plant and site drains would be directed to a sump. Typical finished surface gradients on the plant pad would not be less than 1 percent. Culvert and storm drains would be graded to produce minimum flow velocities in pipes of 2 feet per second for a mean annual rain.

Power Plant Erection: After the power plant site has been prepared by clearing and grading, erection of the power plant facilities would begin. All crushed rock used in the plant would be brought in from established sources. The principal equipment to be used in power plant erection activities would include:

- Lift cranes
- Back-hoe or front-end loaders
- Welding machines
- Air compressors
- A concrete batch plant and pump
- Transit mix trucks
- Low-boy trucks and pickup trucks
- Water trucks

Initial plant erection activities at the plant site would be directed toward development of the turbine/generator building. The site for this building would first be excavated, and the building foundations would then be constructed. The turbine/generator building shell would be erected at the earliest time possible during the first construction season at the plant site so that enclosed structures would be available prior to the onset of winter. This would permit work to continue during the winter months on construction of the turbine pedestal and other equipment foundations within the shelter of the building. Following the completion of the equipment foundations within the turbine/generator building, the installation of the turbines, generators, and associated auxiliary equipment in the building would begin.

During the second and final plant construction season, the remaining plant site facilities such as the cooling tower, service and dormitory building, and H_2S abatement system would be constructed. Level areas within the power plant site boundaries would then be finished with gravel or asphalt. All cut and fill slopes would be seeded or planted

with native grasses and/or shrubs, as directed by USFS. At the end of construction, all temporary buildings would be removed from the site, and all surplus materials and waste would be disposed of at approved disposal sites.

Winter Operating Conditions

Weather during the winter months in the Medicine Lake area is severe. The facilities at the proposed power plant site (as well as the wellfield facilities) would be designed to withstand these weather conditions, and the severe winter weather would require special operating conditions during frequent snowfall.

As illustrated in Figure 2.2-5, the major structures at the power plant site would have sloped roofs designed to allow snow to slide off of the roofs, and to minimize weight loads on the roofs. All major facilities at the power plant site such as the power plant, control room, cooling tower, workshop, and dormitory and service building would be accessible via a covered walkway. Enclosures of sufficient strength for snow loads would be provided for all instrumentation and electric facilities, but no access would be maintained.

During the winter months, snow would be removed from within the boundaries of the plant site and stockpiled at a designated soil spoil site (used for excess cut material from pad and road construction) adjoining the plant site area. Some of this snow could also be placed directly into the cooling tower basin, be allowed to melt, and be piped with the injection fluids to the proposed injection wells for injection into the geothermal reservoir.

In the wellfield, snow would be allowed to accumulate over all wellfield equipment. Small diameter pipe stanchions of sufficient height to be used as navigational aids in large snowdrifts would mark all critical wellfield equipment. If a wellfield equipment failure (such as a problem with the individual wellhead piping to the isolation valve on the main steam header) occurs during the winter months, plant personnel would utilize on-site transportation (i.e., sno-cat and snowmobiles) to reach the problem area. These personnel would then excavate the snow from around the site to fix the failure.

TRANSMISSION LINE AND SUBSTATION

The proposed transmission line for the Fourmile Hill Geothermal Project would be a 230-kV line that would extend east from the proposed geothermal power plant site to a connection with the existing BPA Malin-Warner transmission line (see Figure 2.2-2). The proposed transmission line route would be approximately 24 miles long, and the right-of-way width for the line would be 125 feet. The line would transmit electricity generated by the power plant's generators to the BPA Malin-Warner transmission line. The proposed transmission line would be connected to the BPA Malin-Warner line at a proposed intertie substation site near Perez, California (see Figure 2.2-2). This substation would integrate the power from the proposed action into the BPA transmission system.

The information in this section on transmission line routing, capacity, design, construction methods, and operation has been developed through consultations with staff at G.E. Raleigh and Associates, which is acting as Calpine's transmission line engineering firm for the proposed project. G.E. Raleigh staff have also been consulted

regarding the design, construction, and operation of the proposed intertie substation. The information in this section is also partially based on the transmission line report prepared by G.E. Raleigh for the proposed project (G.E. Raleigh 1997).

Transmission Line Route

Route Development: In 1994, Calpine began a review of transmission line design and routing options for the proposed action. During preliminary design activities, Calpine identified a transmission line corridor that would extend from the proposed power plant site for 24 miles to a connection with the BPA Malin-Warner transmission line. A transmission line corridor heading east from the power plant was identified primarily due to constraints in locating a transmission line to the north, west, or south (see Section 2.4 for more information on why these alternatives were rejected from detailed consideration).

A series of discussions with Federal, state, and county agency and utility company representatives was conducted over the next year to gather preliminary data and suggestions for possible transmission line routes heading east from the Fourmile Hill area to a connection with the BPA Malin-Warner transmission line. In addition to these discussions, Calpine reviewed environmental resource information contained in the Supplemental Environmental Assessment (EA) for potential exploration, development, production, and utilization of the Glass Mountain geothermal resource (BLM and USFS 1984). This EA provided information on siting constraints in the project vicinity due to geologic features, wildlife and critical habitat uses, recreation areas, and visual resources.

Calpine also reviewed resource survey information obtained during preparation of the EA/IS for Calpine's proposed geothermal exploration project in the Fourmile Hill vicinity (BLM et al. 1995) to identify sensitive environmental areas and resources that should be avoided by the transmission line route. Topographic maps were reviewed to identify preliminary routes that would be feasible from an engineering and cost standpoint. Finally, aerial photo lines were flown, and the photographs were examined to refine the topographic positioning of the transmission line routes.

Proposed Route: The proposed transmission line route is comprised of four route segments, which are designated as segments A1, A2, B1, and C1 (see Figure 2.2-2). Table 2.2-2 provides a summary of the location and length of each segment of the proposed transmission line route.

Transmission Line Capacity

In preliminary design discussions with the USFS about the proposed Fourmile Hill Geothermal Project, the USFS expressed a preference that the proposed transmission line for the project be designed to accommodate not only the net electrical power output of 44.9 MW from the proposed project, but also reasonably foreseeable geothermal power generation that could occur at the Glass Mountain KGRA. Development of a transmission line with sufficient capacity for reasonably foreseeable geothermal projects would reduce the number of transmission lines extending from geothermal projects in the Glass Mountain KGRA. Excess capacity would minimize the potential for environmental effects from transmission line construction such as vegetation and habitat removal, visual effects, and potential disturbance of cultural resources.

Table 2.2-2: Transmission Line Route Segments for the Proposed Action

Segment Number	Segment Location	Length (Miles)
A1	Extends southeast from the power plant approximately 2 miles towards Medicine Lake, then east for approximately 3 miles to a point south of Mt. Hoffman and east of Arnica Sink.	4.72
A2	Extends northeast from the endpoint of segment A1 between Mt. Hoffman and Glass Mountain to the "matchpoint" about one mile south of Indian Butte.	3.67
B1	Extends east from the endpoint of segment A2 at the matchpoint for approximately 6 miles, then turns to the northeast for approximately 1 mile to the COTP 500-kV transmission line.	6.78
C1	Extends northeast from the endpoint of segment B1 for approximately 2 miles, then turns due east for 6 miles to a connection with the BPA Malin-Warner transmission line.	8.27

SOURCE: G.E. Raleigh and Associates, Inc. 1997; MHA Environmental Consulting, Inc. 1997

The geothermal resource at the Glass Mountain KGRA was initially calculated to have the potential to produce an estimated 550 MW of electric power for a 30-year period (BLM and USFS 1984). However, this estimate was developed without drilling or testing a proven resource. The actual potential in the resource could be much lower. Development of this potential is not considered to be reasonably foreseeable at this time. Only two potential geothermal power generation projects are currently under consideration at the Glass Mountain KGRA; reasonably foreseeable projects would generate an estimated total net electrical power output of approximately 90 MW (see Chapter 5 of this EIS/EIR for a discussion of cumulative projects and their potential environmental effects).

Based on the USFS preference to have a transmission line that can accommodate reasonably foreseeable future geothermal power generation, the proposed Calpine line has been designed with a capacity beyond that necessary to support the proposed Fourmile Hill geothermal project. The proposed transmission line would have an effective capacity of 145 MW, although it would have a design capacity of 300 MW to the tie-in with the BPA Malin-Warner line.

The reason that the effective capacity of the proposed transmission line would be limited to 145 MW is due to limitations in electrical loading capabilities of the BPA Malin-Warner transmission line. On behalf of Calpine Corporation, BPA prepared a system integration study to evaluate the effect of integrating the electrical load generated by the proposed action into the regional power transmission system (BPA 1995). This study indicates that the Malin-Warner transmission line can handle up to 145 MW of additional electrical load from the proposed transmission line with minimal effect on the system. With this electrical loading, the existing PacifiCorp transmission system north of Alturas would become somewhat unstable under heavy wintertime south-to-north power flow conditions. However, the additional electrical load and

corresponding instability under heavy wintertime conditions would not require the shut down of generators at the proposed Fourmile Hill geothermal power plant.

If the electric load on the proposed transmission line were to be increased to over 145 MW, the combination of this load with moderate wintertime south-to-north power flow conditions would cause the PacifiCorp transmission system to become unstable. Since moderate wintertime conditions occur much more frequently than heavy wintertime conditions, system instability would occur much more frequently with higher electric loads. In addition, the proposed Fourmile Hill geothermal power plant (and any other future geothermal power generation projects connected to the proposed transmission line) would be required to shut down generators until such time as power flows decrease on the BPA Malin-Warner transmission line. It is estimated that these outage conditions would occur from two to four weeks annually (BPA 1995). Since it is desirable from an economic standpoint to avoid these outage conditions, the effective capacity of the proposed transmission line would be limited to 145 MW.

Calpine is proposing a 230-kV transmission line for the proposed project. This type of line is proposed because transmission lines with lower voltages (such as 115 kV) either could not transmit, or would uneconomically transmit, the proposed effective capacity of the line.

Transmission Line Design

The proposed transmission line would begin at the transformer site at the proposed power plant, and would end at a substation located along the existing BPA Malin-Warner transmission line. The proposed transmission line would extend through three fairly distinct regions:

- **Medicine Lake Highlands:** The portion of the transmission line route that extends from the proposed power plant site to approximately the Siskiyou/Modoc county line is located in the Medicine Lake Highlands. This region is generally characterized by rugged terrain, moderately dense forested areas, and extreme winter conditions, including deep snow and freezing temperatures. Segments A1, A2, and the western half of B1 would be located in this region.
- **Transition:** The portion of the transmission line route that extends from approximately the Siskiyou/Modoc county line to the existing COTP transmission line is located in an area referred to as "Transition." This area is generally located on the eastern-facing slope of the Highlands, and is characterized by down-sloping terrain, some forested areas, and more moderate winter conditions (i.e., less frequent and deep snow and freezing temperatures). The eastern half of segment B1 would be located in this region.
- **Modoc Plateau:** The portion of the transmission line route that extends from the existing COTP transmission line to the proposed substation is located on the Modoc Plateau. This region is generally characterized by relatively flat terrain, predominately shrublands, and more moderate winter conditions (i.e., occasional snow and freezing temperatures). Segment C1 would be located entirely in the Modoc Plateau.

The unique conditions and constraints in each of these regions has been considered in the design of the proposed transmission line. In addition, the line has been designed to meet or exceed the standards of the National Electric Safety Code and to conform with

California Heavy Loading criteria, which complies with the requirements set forth in California General Order No. 95 for transmission lines in elevations above 3,000 feet.

The proposed transmission line would basically consist of support structures and the conductors (i.e., the actual power lines), which are described below.

Transmission Line Support Structures: Three types of support structures would generally be used for the proposed transmission line:

- H-Frame (i.e., two-pole) structures
- Three-pole structures
- Single steel pole structures

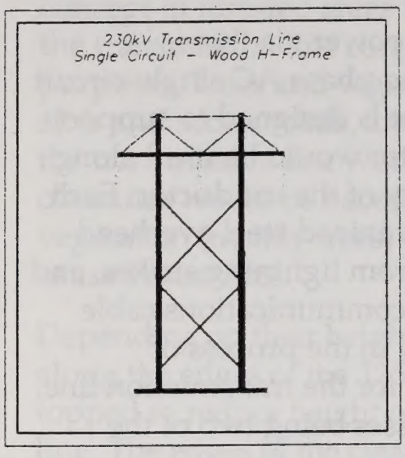
Figure 2.2-9 illustrates each of the types of transmission line support structures that would be used. Wood poles would primarily be used for the support structures, which would serve to blend in and minimize visual contracts with the surrounding Forest. The spacing (i.e., span length) between each transmission line support structure would vary from 500 to 900 feet, with an average of 7.5 support structures per mile. The actual span length between each structure would depend on several factors, including the terrain between the support structures, the line elevation and associated expected ice and wind loadings, and the expected conductor sags and tensions due to ice and wind loadings. In general, shorter spans would be required in higher elevations with varied terrain and more extreme weather conditions (such as the Medicine Lake Highlands), and longer spans could be used in more flat and temperate area (such as the Modoc Plateau). The following discussion describes the basic design of each structure type.

H-Frame structures would be the primary type of support structure that would be used along the transmission line. These structures would be comprised of two vertical wood poles approximately 30 inches in diameter, with a nominal 19.5-foot spacing between the two poles (see Figure 2.2-9). Each structure would have a wood or steel crossbrace and a wood or steel crossarm with an internal vee-brace assembly. H-frame structures would generally range from 60 to 80 feet in height.

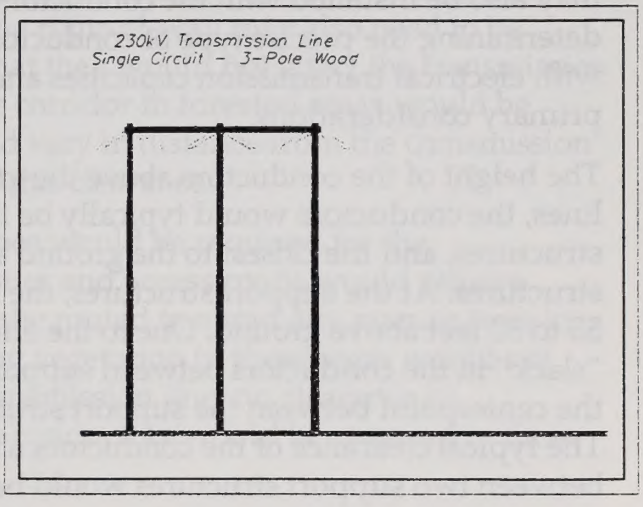
At most angle points (i.e., locations where the transmission line route would change directions) and selected dead-end locations, H-Frame support structures would not provide the necessary support or stability for the transmission line. At these points, three-pole support structures would generally be utilized. Similar to H-Frame structures, the three-pole structures would be comprised of vertical wood poles approximately 30 inches in diameter, and would range from 60 to 80 feet in height. However, three vertical poles would be used in three-pole support structures rather than two poles. The spacing between each of the poles of a typical three-pole structure would be approximately 19.5 feet. Each structure would have a wood or steel crossarm with an internal vee-brace assembly. The three-pole structures would utilize "guy" lines (i.e., thin wires extending at an angle from the tops of the structures to the ground) that would provide structural stability (see Figure 2.2-9).

If necessary due to topographic conditions or potentially extreme snow loading, a self-supporting single steel pole support structures may be used at select locations. Each single pole structure would be comprised of a steel pole approximately 30 inches in

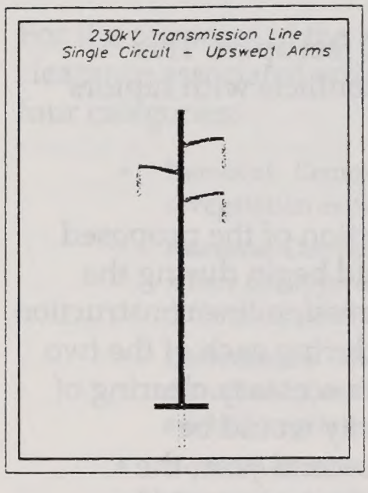
Figure 2.2-9: Transmission Line Support Structures



Wood pole H-Frame — primary proposed transmission line structure



Guyed, three pole structure — for use at most angle points



Self-supporting single steel pole — alternative proposed structure

diameter, with steel davit arms and I-string suspension insulators (see Figure 2.2-9). The height of single steel pole structures would generally range from 65 to 95 feet.

Conductors: The proposed transmission line would transmit power via three conductors. Each conductor would carry one phase of the three-phase AC single-circuit transmission line, and each transmission line support structure is designed to support the three conductors (see Figure 2.2-9). Non-reflective conductor would be used along the entire length of the transmission line to reduce the visibility of the conductor. Each transmission line structure would also support a 3/8-inch galvanized steel overhead shield wire that would be installed to protect the conductors from lightning strikes, and to provide protection for the transmission system. Fiber optic communications cable may also be installed with the conductors. Calpine is currently in the process of determining the precise type of conductor that would be used for the transmission line, with electrical transmission capacities and projected power losses being two of the primary considerations.

The height of the conductors above the ground would vary. As with other transmission lines, the conductors would typically be the farthest from the ground at the support structures, and the closest to the ground at the centerpoint between two support structures. At the support structures, the conductors would generally be located about 55 to 80 feet above ground. Due to the effect of gravity and the need to allow some "slack" in the conductors between support structures, the height of the conductors at the centerpoint between the support structures would be lower than at the structures. The typical clearance of the conductors above the ground surface at the center point between two support structures would be about 30 to 37 feet.

The space between conductors would be approximately 18 to 20 feet apart. This distance is designed to maintain electrical clearance and avoid conflicts with raptors (see Section 4.8).

Transmission Line Construction

As discussed later in this section under "Schedule," the construction of the proposed transmission line would occur over a two-year period, and would begin during the second year of the 33-month project construction period. Transmission line construction activities would generally occur between April and November during each of the two years of transmission line construction. During the first year, all necessary clearing of vegetation within the 125-foot-wide transmission line right-of-way would be conducted, and access roads would be constructed. During the second year, the transmission line support structures would be installed, the conductors would be strung, and selected areas within the transmission line right-of-way would be revegetated. A detailed discussion of the specific construction activities that would occur is provided below, in the following approximate sequential order of transmission line construction:

- Vegetation clearance within the transmission line right-of-way
- Construction of access roads
- Support structure installation
- Conductor installation
- Right-of-way clean-up and revegetation

Vegetation Clearance: Calpine would minimize the amount of vegetation clearance that would be required for construction of the proposed transmission line. The general concept in forested areas would be to clear trees and vegetation only from portions of the transmission line corridor where clearance is necessary for operational or safety purposes. Trees and vegetation would be completely cleared from support structure sites and access roads, and only necessary trees and vegetation that might interfere with the transmission line would be cleared from directly underneath the conductors. This clearance would be necessary to ensure line safety and minimize the potential for vegetation (mainly trees) to touch the conductors, which could short the line and/or cause Forest fires.

Depending on their height and location, additional trees and vegetation within but along the edges of the 125-foot transmission line right-of-way may also need to be topped to reduce height or cleared to ensure that they would not affect the transmission line. The edges of the cleared transmission line corridor in forested areas would be "scalloped" (i.e., the edges would undulate and vary in distance from the transmission line centerline) to minimize the visual effect of this clearance.

In shrubland areas, minimal vegetation clearance would be required for the transmission line. Only the support structure sites and access roads would require vegetation clearance. The line would generally be routed to avoid any mature trees in shrubland areas. Since the shrubs and low-lying vegetation in these areas would not pose a threat to the safety or integrity of the transmission line, no clearance or disturbance of vegetation from underneath the conductors would be required in these areas.

For the purposes of the analysis in this document, ground disturbance and vegetation clearance associated with construction of the transmission line has been divided into four categories:

- **Removal:** Removal would involve complete removal of vegetation, with no revegetation expected to occur during the lifespan of the proposed project.
- **Removal-Conversion:** The removal-conversion category would include areas where one type of vegetation (such as Forest) is removed and replanted with a different type of vegetation (such as a grass and/or shrub seed mix).
- **Disturbance:** The disturbance category includes areas where vegetation is disturbed by activities such as tree topping, but stays essentially the same (i.e., existing vegetation is not cleared, and conversion does not occur).
- **No Disturbance:** Areas that are categorized as "no disturbance" would generally not require vegetation removal or modification, except for removal of dispersed taller trees.

The three regions crossed by the proposed transmission line route (Medicine Lake Highlands, Transition, and Modoc Plateau) would each involve different combinations of ground disturbance and vegetation clearance in order to construct the transmission line. Table 2.2-3 identifies the acreage of each type of ground disturbance and vegetation clearance that would occur in each region. Sections 3.7 and 4.7, Vegetation describe the particular type of vegetation that exist along the transmission line route and would be affected by the proposed action. The following discussion describes the

Table 2.2-3: Transmission Line Ground Disturbance and Vegetation Clearance (acres)

	Removal[1]	Removal-Conversion[2]	Disturbance[3]	No Disturbance[4]	Total Disturbed
Transmission Line					
Highlands	21.36	116.69	34.51	-	172.56
Transition	7.10	19.35	30.81	-	57.27
Plateau	14.49	-	0.30	110.50	14.79
Subtotal	42.95	136.04	65.62	110.50	244.62
Access Roads					
Highlands	56.92	-	-	-	56.92
Transition	18.69	-	-	-	18.69
Plateau	6.01	-	9.61	-	15.61
Subtotal	81.61	-	9.61	-	91.22
Total	**124.56**	**136.04**	**75.23**	**110.50**	**335.83**

Notes:

1 Includes the 100-foot by 100-foot (10,000 square feet) transmission line support structure area, with an average of 7.5 structures per mile; also includes bladed access roads.

2 Includes areas underneath the proposed transmission line that would require tree removal and result in conversion of vegetation type.

3 Includes areas where trees would be topped, but not removed; also includes non-bladed access roads.

4 Includes areas where vegetation clearance would generally not be required, except for removal of dispersed taller trees.

SOURCE: G.E. Raleigh and Associates 1997

general ground disturbance and vegetation clearance methods that would be required in each region.

Medicine Lake Highlands: The Medicine Lake Highlands is primarily a densely forested area. In the portion of this region that is crossed by the transmission line route, most trees range from 50 to 75 feet tall, and there is little understory. As discussed above, the typical clearance of the conductors above the ground at its lowest point would be about 30 to 37 feet in order to meet the requirements of the National Electric Safety Code and California General Order No. 95. A minimum 15-foot clearance would be required between the tops of vegetation and the conductor. This requirement would limit the maximum height of vegetation under the line to about 15 to 22 feet.

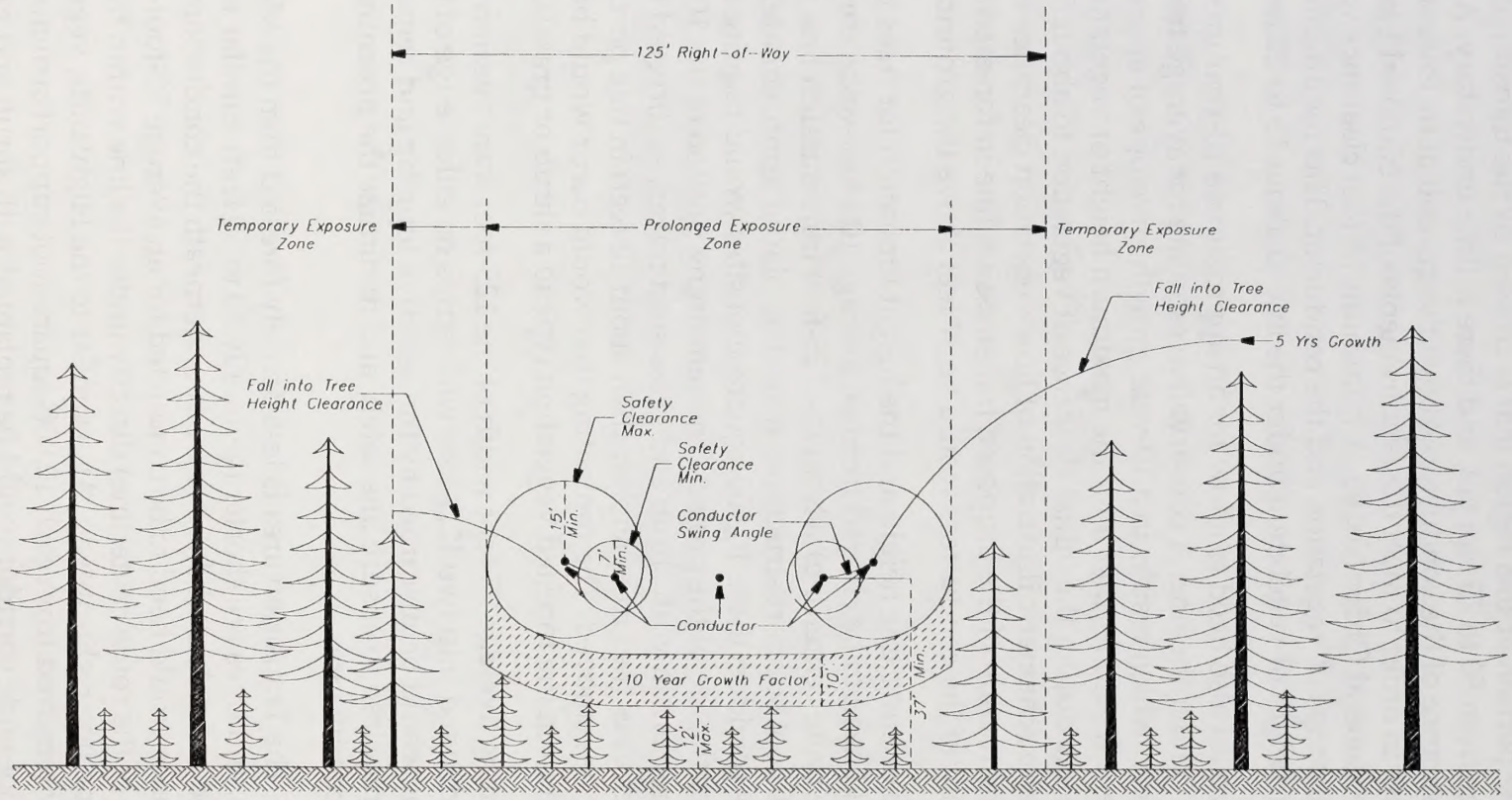
Calpine would also need to allow for an approximate 10-year growth envelope for vegetation under the line. A conservative estimate for average tree growth is about one foot per year, which results in a 10-year growth envelope of approximately 10 feet. This requirement would further limit the maximum height of vegetation that could be left under the line during the initial clearance of vegetation to about 5 to 12 feet. Figure 2.2-10 provides a schematic illustration of how vegetation clearance would be conducted for the construction of the proposed transmission line in forested areas where the lowest point of the conductors would be 37 feet above the ground.

Due to the existing tree height and the height limitation for trees in this region, most trees would need to be cleared from an average 100-foot-wide corridor (50 feet on either side of the route centerline) within the 125-foot transmission line right-of-way. The 100-foot by 100-foot support structures would be placed approximately every 500 to 900 feet within this corridor; these 10,000-square-foot sites would require complete vegetation removal for the life of the project. The remaining portion of the 100-foot-wide corridor would be replanted with shrub and grass seed mixes, as directed by the USFS, and the few smaller trees (i.e., trees shorter than about 12 feet) in this portion of the corridor would not be removed. The replanting that would occur would be considered a conversion from the forested vegetation type to a shrub or grassland vegetation type.

The remaining average 25-foot width of the 125-foot transmission line right-of-way would be divided into two 12.5-foot wide strips on either edge of the right-of-way. These areas would be disturbed by the selective topping and removal of trees that would be required to ensure line safety and minimize the potential for these trees to touch the conductors.

Transition: The Transition area is less densely forested than the Medicine Lake Highlands, and trees are shorter (generally 30 to 50 feet). Similar to the Highlands, trees would need to be cleared directly from underneath the conductors to ensure line safety. This clearance would need to be conducted for an average 50-foot-wide path (25 feet on either side of the route centerline) directly under the line within the 125-foot transmission line right-of-way. Also similar to the Highlands, vegetation would be completely removed from each 10,000-square-foot support structure site. The remainder of the 50-foot-wide corridor would be replanted with shrub and grass seed mixes, which would be considered a conversion of vegetation type. The few smaller trees (i.e., trees shorter than about 12 feet) in this portion of the corridor would not be removed.

Figure 2.2-10: Typical Right-of-Way Clearing



The portions of the transmission line right-of-way that would not require vegetation removal and/or conversion in the Transition area would be disturbed by selective tree topping and removal to ensure line safety. This disturbance would affect two 37.5-foot wide strips on either edge of the right-of-way in this area.

Modoc Plateau: The Modoc Plateau consists almost entirely of scrub and grassland, with a few scattered trees. Vegetation clearance in this region would consist of clearance of support structure sites and bladed access roads. The line would generally be routed to avoid mature trees in this region. Since the shrubs and low-lying vegetation on the Modoc Plateau would generally not pose a threat to the safety or integrity of the transmission line, minimal clearance or disturbance of vegetation from underneath the conductors would be required in this area.

Access Road Construction: Construction of access roads for the proposed transmission line would occur concurrently with vegetation clearance from the transmission line route. These access roads would be needed primarily to access the proposed transmission line structure sites. Access road construction would involve a combination of upgrading and improving existing access roads that cross the proposed transmission line route, and installing new roads in areas where there is currently no road access. By utilizing existing access roads to the greatest extent possible, new road construction would be kept to a minimum. Table 2.2-3 identifies the acreage of surface disturbance that would result from access road construction.

All transmission line access roads (both improved and new) would be constructed with a 12-foot travel way. When factoring in cut and fill requirements in sloped areas, it is expected that construction of access roads would typically disturb an area from 20 to 50 feet wide, depending on grade and sideslope. For existing road improvements, road construction would generally involve clearing overgrown vegetation from the roadway and regrading of the roadway surface. Most access roads would need to be bladed to ensure a safe driving surface, particularly in hilly terrain. However, in scrubland areas such as the Modoc Plateau, access roads would generally not be bladed, and overland travel on marked routes would be used where practical. All access roads would be designed with water bars, dips, and culverts to allow for drainage, while minimizing the potential for erosion. Public access on transmission line access roads would be limited by the use of gates where appropriate and as directed by the USFS.

The majority of the proposed transmission line route parallels existing roads in the area. At these locations, Calpine proposes to improve existing or construct new short spur roads from the existing roads to the proposed transmission line structure sites. These improved and new access roads would range from 50 to 800 feet in length, with an average length of approximately 400 feet.

In areas where there are no adjacent existing roads, new access roads would be constructed within the transmission line right-of-way to provide access to support structure sites. Typically, access roads in these areas would begin at a support structure site that would be accessible from a spur road off of an existing road. The access roads would then extend from structure site to structure site. Consistent with the expected spacing of the support structures, the roads between the structure sites would be between 500 and 900 feet in length. These roads would be constructed within the

cleared areas directly underneath the conductors, and would generally be installed in a serpentine (i.e., non-linear) manner in order to minimize their effect on views. The maximum grade of these roads would be fifteen percent.

Equipment and vehicles that would be used for access road construction would include typical road construction equipment such as bulldozers, drag lines, dumptrucks, graders, buncher-fallers, skidders, and crew-haul vehicles.

Support Structure Installation: In order to install each transmission line support structure, a 100-foot by 100-foot cleared area (10,000 square feet) would be required at each site. The access roads described above would provide construction access to each site. The cleared area at each site would be required to allow for construction vehicles to maneuver around the site, and to ensure adequate space for erection of the support structures. Structure installation activities would include:

- Pre-assembly of select support structure components
- Delivery of support structure components and materials
- Assembly of support structure components
- Excavation of pole holes and installation of structure footings (if required)
- Erection of the support structure
- Installation of guys and anchors (if any)
- Installation of counterpoise (i.e., structure grounding)

Typical construction equipment that would be used for structure installation at each site would include a bulldozer, backhoe, auger/drill rig (typically mounted on a 5-ton truck), crane, and dump truck. The bulldozer would be used for leveling of each support structure site. The backhoe and auger/drill would be used to excavate the holes for poles and foundations. The crane would be used to lift support structures into place. The dump truck would be used for general construction activities, such as moving materials around the site. In areas with shallow bedrock, blasting equipment would also be required. For single steel pole support structures, a concrete mixer may also need to be present at structure sites where a concrete pier foundation would be required.

Prior to actual delivery of support structure components and materials to each structure site, select transmission line parts such as insulators and internal bracing systems would be pre-assembled. The proposed substation and power plant sites would most likely be used as temporary staging areas for this pre-assembly. These staging areas would also be used to store transmission line materials such as poles and conductors.

Delivery vehicles such as flatbed trucks would generally be used to deliver pre-assembled and additional support structure components and materials to each structure site. In hilly and rugged terrain, poles would be skidded to the site with a bulldozer or pole-haul trailer. Major support structure components and materials would be delivered in two to three trips per site.

After components and materials are delivered to the site, the support structures would be assembled on the ground at each site. For H-frame and three-pole support structures, the cross arms and internal bracing systems would be bolted to the wood poles. For single steel poles, davit arms would be attached to the steel poles. For all support

structures, handlines, insulator strings, and stringing travelers would be installed on the support structures. These components would provide for increased safety and integrity of the transmission line during operation, and are items that would be necessary to ensure that the conductor is fully supported. Typically, about four to six support structures would be assembled per day.

During the assembly of the support structures, holes for the support structure poles and foundations would also be excavated with the backhoe and auger/drill. Occasional directed blasting may also be required in areas with shallow bedrock to excavate pole holes and foundations. At locations where steel poles may be used, these poles could be buried with crushed rock or concrete backfill, depending on geological conditions. Rock anchors would be installed in bedrock areas for steel pole foundations, and some blasting would be required. Otherwise, a concrete pier foundation with anchor bolts would be constructed.

Once a support structure is assembled and the pole holes and foundations are established, the support structure would be erected into position with the crane. Guy wires would then be installed on three-pole structures, and anchors would be put in place at foundations that require anchor bolts. Typically, about four to five support structures would be erected per day.

Based on previous experience with transmission lines, it is expected that about 10 percent of the structures for the proposed transmission line would require counterpoise, which are lengths of bare aluminum wire. Counterpoise is required where the electrical resistivity of the soil is too great to allow for adequate grounding of a support structure. For the proposed transmission line, one to six 100- to 250-foot lengths of counterpoise would be installed for those structures where counterpoise is required.

For those structures where counterpoise is required, each length of counterpoise would be attached to the structure at one end and to a galvanized steel rod driven into the earth at the other end, and the length of counterpoise would then be buried in the ground. Burial would be done by hand-trenching, plowing in by tractor or bulldozer, or by machine trenching within the area cleared for the structure site. The counterpoise would be installed at a minimum depth of 12 inches in uncultivated soil, and 24 inches under roads. If solid rock is encountered, the counterpoise would be laid in cracks or on the surface, in which case loose rock or soil would be placed on the wire to hold it down. Once the counterpoise is buried, the area affected by installation would be revegetated.

Each H-Frame would have a direct footprint of approximately 60 square feet. This estimate is based on a total ground disturbance radius of 3.0 feet for each pole, which equates to about 30 square feet for each pole (or 60 square feet for both poles). The three-pole support structures would each have a footprint of approximately 120 square feet, which would include 90 square feet for the poles, and 30 square feet for the guy wire anchors (six anchors each with a footprint of five square feet). The single steel pool structures would have a direct footprint of about 30 square feet.

Conductor Installation: After the transmission line support structures are in place, the conductors would be strung along the route and tensioned. Conductor installation would require the establishment of pulling sites, which would be established at two-mile intervals along the route. These sites would serve as the primary staging areas for conductor installation, and equipment and materials related to conductor installation (such as wire trailers, pullers, tension machines, and crawler tractors) would be stored at these sites. The pulling sites would be located on the 10,000-square-foot areas that would be cleared for the support structures, and would not require new surface disturbance. The installation of conductors would involve a three-step process:

- Installation of pull ropes (socklines)
- Pulling of conductors and the shield wire
- Sagging and connection of conductors and the shield wire to the support structures

The three-step process would be performed between each pulling site, and would therefore reoccur every two miles (covering approximately 15 support structures). The process would be repeated sequentially along the entire length of the transmission line route until the entire length of the transmission line is in place.

The first step in conductor installation would be the installation of socklines. Each of the three conductors that would be installed would require its own sockline. Beginning at one of the pulling sites, a helicopter would be used to pull each sockline from the pulling site to the next pulling site. The socklines would be pulled through the stringing traveler sheaves on each support structure.

After the socklines are in place, the conductors and 3/8-inch galvanized steel overhead shield wire would be installed. A typical conductor installation would involve the placement of a large spool of conductor wire at one of the pulling sites. One end of the conductor would be attached to a helicopter, which would unroll the conductor by flying from the pulling site along the transmission line route to the next pulling site. The conductors would be pulled through the stringing traveler sheaves on each support structure. Tension machines would be used to help keep the conductors clear of the ground. This process would be repeated for each of the three conductors and the shield wire.

After the conductors are pulled, the conductor would be attached to the insulator strings on each support structure. The end of each length of conductor would then be connected to the end of the next length of conductor that has already been installed along the transmission line route. Splice connectors or field sleeves would be installed where the separate conductor lengths would be joined. The conductors would then be sagged to the proper tension by cable pullers located at the pulling sites. After sagging, the conductors would be marked and installed in the assemblies used to attach the conductors to the insulator strings (an operation is referred to as "clipping").

Right-of-Way Clean-Up and Revegetation: Upon completion of transmission line construction, clean-up of the transmission line right-of-way would occur. Two to three tractors plus a skidder would be used for clean-up of the right-of-way, and this clean-up would be expected to progress at approximately one-half mile per day. All debris, unused material, and unneeded equipment would be removed from the right-of-way

and access roads. Any remaining cleared vegetation would be disposed of in accordance with USFS specifications, and would be expected to be hauled from the site for disposal, or scattered over open areas in the right-of-way vicinity. Permanent access roads for the transmission line right-of-way would be closed with barriers and signs, as directed by the USFS.

In addition to the removal of debris, unused material, and unneeded equipment, revegetation of the transmission line right-of-way would be conducted after the transmission line is installed. Revegetation would primarily involve the use of a grass or shrub seed mix to revegetate areas. As shown in Table 2.2-3, this revegetation would be considered a conversion of vegetation type in existing forested areas, as areas within the right-of-way that had been vegetated by trees before transmission line construction would be converted into grass or shrubland after development of the transmission line. Reseeding and/or replanting within the right-of-way would be performed in accordance with USFS specifications. Temporary roads would be regraded to approximately original contours and revegetated.

Transmission Line Operation

During the operational phase of the proposed project, the main project activities associated with the proposed transmission line would be inspection and maintenance activities for the line. A combination of regularly-scheduled, periodic, and emergency inspections and maintenance of the line would be expected during the lifespan of the proposed action. Regularly-scheduled and periodic inspections and maintenance would be conducted as part of normal operating procedures to ensure that the line remains in safe operating condition. Emergency inspections and maintenance would be required to fix problems such as downed power lines, or repair support structures damaged in storms.

Regularly-Scheduled Inspections and Maintenance: Full-scale inspections and maintenance would be scheduled on a regular basis for the transmission line. These inspections and maintenance would normally occur twice annually over the lifespan of project operations. The inspections would be conducted by helicopter in the spring after snowmelt, and by four-wheel drive vehicle in the fall before snowfall. The inspections would be conducted as a preventative measure to identify any problems with the transmission line as early as possible.

Full-scale inspections and maintenance would generally involve visual inspections of components such as transmission line support structures, conductors, and hardware. Climbing inspections, pole testing, and anchor testing would also be conducted. General maintenance such as bolt tightening and pole and hardware repair and replacement would be performed on an as-needed basis during regularly-scheduled inspections and maintenance.

Periodic Inspections and Maintenance: Periodic patrols of the transmission line would also be conducted to ensure that the line remains in safe working order during the operational phase. These patrols would be conducted on an intermittent basis, and the same types of activities described for regularly-scheduled inspections and maintenance would occur during periodic inspections and maintenance.

Periodic maintenance would also be required for vegetation control during project operation. As discussed above under vegetation clearance during transmission line construction, the transmission line right-of-way would need to be maintained to meet the requirements of the National Electric Safety Code and California General Order No. 95. Trees and other tall vegetation would need to be kept clear from the conductors to minimize the potential for this vegetation to touch the lines, which could short the line and/or cause Forest fires. This clearance would originally be done during the construction phase (see Figure 2.2-10 for an illustration of how vegetation would be cleared from portions of the transmission line right-of-way in forested areas), and periodic vegetation control would need to occur during operation.

Various techniques would be utilized to control or eliminate vegetation growing within or adjacent to the transmission facilities that could interfere with reliable transmission line service. These techniques would involve hand and mechanical cutting of vegetation, but not the use of herbicides. The method of control depends on a number of considerations, including type of vegetation, prevailing weather, accessibility of the terrain, economic cost, and effectiveness.

Emergency Inspections and Maintenance: It is expected that emergency inspections and maintenance of the transmission line would be required at various times during the operation phase. Given the inherent uncertainty as to when emergency situations may occur, it is not possible to predict the number or frequency of emergency inspections and maintenance that would be required over the lifespan of the project. It is expected that the regularly scheduled and periodic inspections and maintenance would minimize the need for emergency inspections and maintenance. However, it is probable that some emergency situations may arise, such as downed power lines or storm-damaged support structures.

When emergency situations arise, qualified repair crews would be immediately mobilized to inspect the situation. Calpine would alert USFS personnel and necessary emergency response agencies of any emergency situation that could pose a threat to humans or represent a fire risk. If weather conditions allow, repairs would be initiated immediately to correct the situation. If severe or extreme weather conditions prevent an immediate response, the repair crews would wait until the weather allows repairs to be safely made.

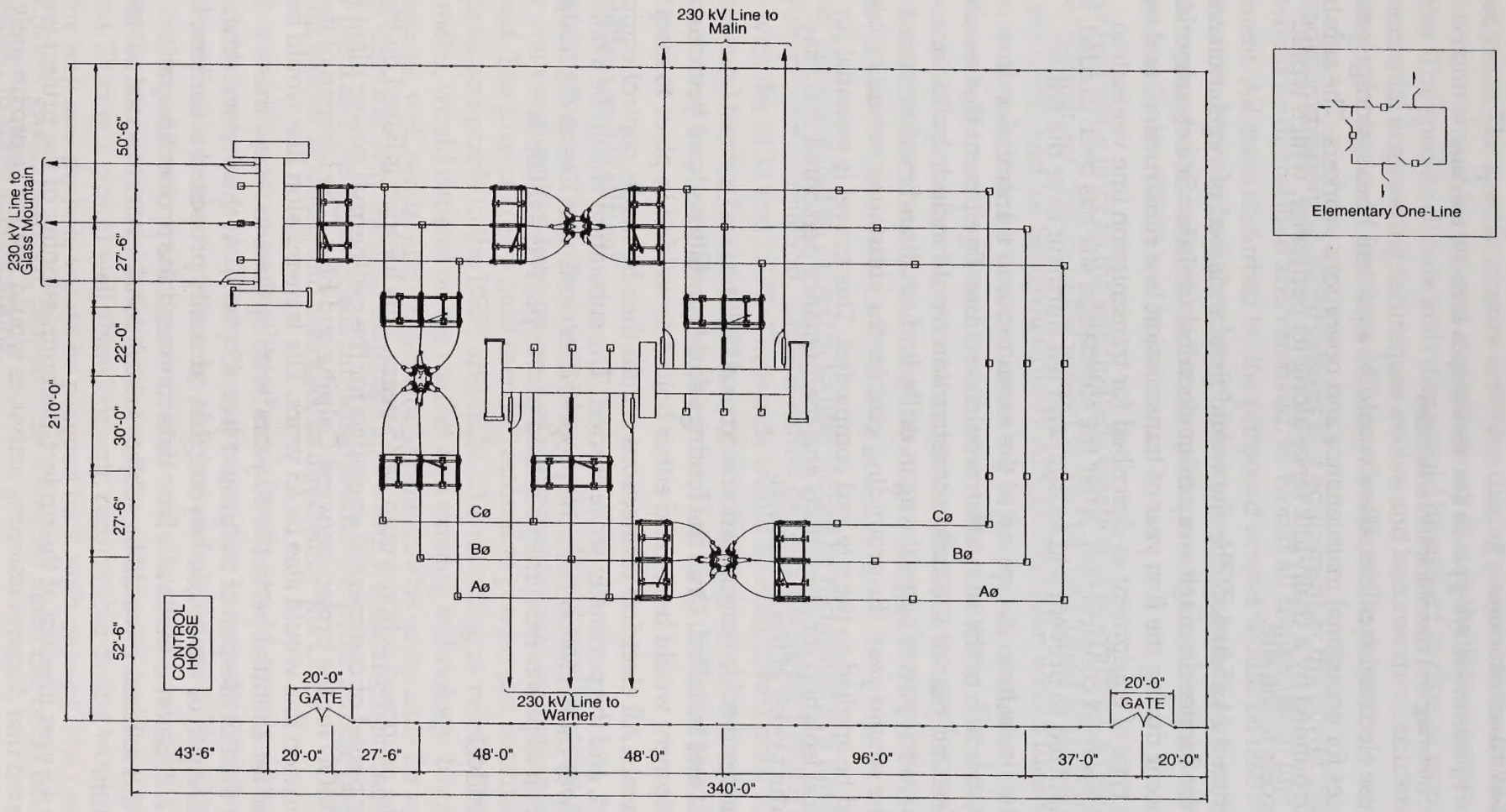
Intertie Substation

Development of the proposed transmission line would also involve construction of a intertie substation on the BPA Malin-Warner transmission line near Perez, California (see Figure 2.2-2). This substation would be used to convey electricity from the proposed transmission line to the Malin-Warner line and into the regional power grid. The proposed substation site would measure approximately 360 feet by 360 feet (about 3.0 acres). The layout of the substation is illustrated in Figure 2.2-11.

The main facilities that would be located at the substation would include:

- The 230-kV main circuit breaker three-ring bus
- The 230-kV isolating switches
- The 230-kV power line carrier equipment

Figure 2.2-11: Substation Layout



MHA *Environmental Consulting, Inc.*

SOURCE: Calpine

- The 230-kV takeoff structures
- Necessary protective relaying panels and devices such as circuit breakers
- Control, metering and communications facilities

In addition to these electrical facilities, there would be a control house, storage yard, and parking spaces for occasional maintenance and operations workers. The substation site would be surrounded by a chain-link fence along its perimeter, which would prevent public access to the site.

In order to construct the substation, the site would first be cleared of vegetation and graded to allow for proper drainage away from electrical facilities. Site clearance and grading would occur during the first year of transmission line construction, and would require the same type of equipment as described for transmission line vegetation clearance and access road construction. After the substation site has been graded, the site would be stabilized to prevent soil erosion and left dormant over the winter.

As soon as weather permits in the spring of the second year of transmission line construction, construction of the substation would continue. Equipment that would be used during the second year of substation construction would include bulldozers, backhoes, dump trucks, power augers, wagon drills, and small and medium sized cranes. During the second year, the grounding grid for the substation would be laid, and gravel would be applied to the site and compacted. This gravel is essential for providing electrical isolation for operations and maintenance personnel that may occasionally conduct work at the substation.

Footings and foundations for the substation electrical facilities and control house would then be excavated and installed. Once the footings and foundations have been installed, the electrical equipment would be set and either bolted or welded in place to meet seismic requirements. All electrical connections would then be made, control equipment extensively tested, and the perimeter fence erected. The substation would be available and ready for power transmission from the proposed transmission line to the Malin-Warner line as soon as power from the proposed power plant is available.

DECOMMISSIONING

Introduction

The lifespan of the proposed action would be 45 years. This lifespan is based on the proposed 45-year period of commercial operation for the geothermal power plant that is identified in the MOU for the project between Calpine and BPA. The lifespan of the proposed transmission line would also be 45 years. The transmission line would be authorized for use for an initial period of 30 years, with options to renew this authorization for the full lifespan of the project (i.e., 45 years). At the present time, no extension of the lifespan of the project beyond that currently proposed is contemplated or envisioned. If a decision is made at a later date to extend the project lifespan, authorization of this extension would be subject to additional environmental review and documentation.

At the end of the 45-year lifespan of the project, decommissioning of the project would occur. It is estimated that decommissioning activities would last for approximately two

to three years. The specific closure activities during project decommissioning discussed in this section should be viewed as preliminary due to the future nature of these activities. The specific closure activities would be subject to change over time as environmental engineering techniques evolve and become more efficient, and as more definitive information is developed during the life of the project.

During decommissioning, all structures and equipment at the power plant site and well pads would be dismantled and removed, as would all transmission line structures and equipment. All areas disturbed by the proposed project would be restored to pre-project conditions and/or to conditions acceptable to the USFS and BLM. Geothermal wells would be plugged and abandoned in compliance with Geothermal Resource Operational Order (GRO) No. 3.

At least two years prior to the anticipated cessation of operations, a decommissioning plan for permanent closure of the project would be developed in cooperation with the BLM, the USFS, and the Siskiyou County APCD. This plan would identify specific actions and a schedule for decommissioning of the project, and identify steps and procedures to restore the project area to acceptable conditions. The decommissioning plan would also provide measures to minimize effects to the geothermal resource, surface water, groundwater, and other resources during decommissioning, and identify how project materials would be recycled.

In order to ensure that all project activities would be reclaimed in a timely manner following project completion, Calpine would be responsible for posting reclamation bonds with the BLM and USFS. The bonds would be established prior to any construction activities, and would be a condition of approval for the proposed action. The bonds may be posted for either the entire Unit Area or for the specific areas affected by the project.

Power Plant and Wellfield

During decommissioning, the power plant and wellfield would be deactivated, and all power plant and wellfield structures and equipment would be dismantled and removed. The project area would then be restored to pre-project conditions or to conditions acceptable to the USFS and BLM. The recycling or reuse of materials, such as scrap metal, would depend on the market and existing technology. Installed piping, well casings, well heads, and valves would probably be unsuitable for reuse and would require disposal. Any residual materials and waste would also be removed from the power plant and wellfield. Roads implemented for the project in the power plant and wellfield would be closed and restored, as directed by the USFS.

Plugging and abandonment of all geothermal wells would comply with GRO Order No. 3, which states that any well that is not in use and no longer demonstrates a capacity for further profitable production must be plugged and abandoned. The BLM may require additional measures to protect groundwater and other resources. GRO Order No. 3 outlines the manner in which the wells are to be abandoned and the surface area is to be restored. During a typical well abandonment, recoverable casing would be salvaged from the well and the hole would be plugged back with cement. The casing would be cut off below ground surface, capped with a welded plate, the cellar back-filled, and the site restored to USFS specifications.

Prior to closing the solids disposal sump at each well pad, the dry sump contents of this sump would be sampled and analyzed to confirm that the material was nonhazardous. If the sump contents were determined to be hazardous, or otherwise determined to be unacceptable for burial in place, the sump contents would be removed and transported to an off-site disposal facility authorized to accept the waste. Upon confirmation that the sump contents were nonhazardous, the sump would be backfilled and graded to contour.

The lined fluid sump would be emptied of any residual fluid and closed in place. The sump liner would be either removed entirely, or the liner would be cut to below ground surface, punctured to allow water to permeate through it, and backfilled with native soil. The entire pad would be regraded to approximate natural contour and scarified to promote revegetation.

Transmission Line

During decommissioning, all transmission line structures and equipment would be dismantled and removed, and the project area restored to pre-project conditions or to conditions acceptable to the USFS and BLM. After the transmission line is deactivated, the transmission line conductors would be disconnected from the power plant and the BPA Malin-Warner line. The conductors would then be removed from the support poles, the support poles would be taken down, and pole footings would be removed. The recycling or reuse of materials, such as scrap metal, would depend on the market and existing technology. Roads implemented for the project to access the transmission line would be closed and restored, as directed by the USFS.

PROJECT SCHEDULE, MANPOWER, AND ECONOMIC BENEFITS

Project Schedule

As previously discussed, the proposed action would involve three phases: construction, operation, and decommissioning. The construction phase would occur over an approximately 33-month period (or about three years), with the majority of project construction work occurring during the three summer seasons (i.e., from April to October). Assuming that the EIS/EIR process is completed by the end of 1998, the construction phase would begin in April 1999 and end in January 2002. The proposed project would only proceed past the construction phase if confirmation well drilling and testing conducted during the first construction season confirms the presence of a commercially viable geothermal resource. The following is a breakdown of the construction schedule by year:

- **Year 1 (April 1999 to March 2000):** Clear two to three production well pads and associated roads in the wellfield area and conduct confirmation well drilling and testing at these well pads during the summer months; if drilling confirms a viable geothermal resource, construct remaining production and injection well pads and associated pipelines and access roads in wellfield.
- **Year 2 (April 2000 to March 2001):** Begin power plant construction, complete drilling and testing of remaining wells, and begin clearance of the transmission line right-of-way and associated access roads; during the winter, continue with construction of the power plant.
- **Year 3 (April 2001 to January 2002):** During the summer months, complete drilling of production and injection wells in the wellfield, complete clearance of the

transmission line right-of-way, install support structures and transmission line, construct substation, and connect transmission line to BPA Malin-Warner line at substation; during the winter, complete construction of the power plant and ensure plant is ready for start-up.

The proposed action would require a three-month check-out and start-up period to ensure that all systems are operational and to test certain functions and plant equipment before commercial energy production. After this three-month period, the project would be brought on-line (i.e., linked to the regional power grid and ready to provide electrical power) by April 2002.

The operational phase of the proposed action would last approximately 45 years. Assuming that the proposed project is brought on-line by April 2002, the project would be operational until about 2047. At the present time, no extension of the lifespan of the project beyond that currently proposed is contemplated or envisioned. If a decision is made at a later date to extend the project lifespan, authorization of this extension would be subject to additional environmental review and documentation.

At the end of the 45-year lifespan of the project, decommissioning of the project would occur. Project decommissioning activities would be similar to project construction activities, and would primarily involve the dismantling and removal of the proposed power plant and associated facilities and the transmission line, the closure of proposed production and injection wells, and the restoration of all areas disturbed by the proposed action. Actual dismantling, removal, and closure activities would be expected to take as long as or less than the three-year construction period. Restoration (including scarification of disturbed sites and planting of replacement vegetation) would occur in conformance with a USFS-approved restoration plan, and would occur within this three-year period.

Manpower

Construction Personnel: It is expected that the number of construction personnel would gradually increase over the 33-month construction period, with the greatest number of construction employees required during the third and final year of project construction. During the first year, construction employees would primarily be associated with proposed well drilling and testing activities. Approximately 10 to 15 construction workers would be required for these activities. The drilling crews may live on location or reside in the nearest available community. A Calpine geologist and drilling foreman, along with the drilling contractor, tool pusher, and contract mud engineer, would live in a self-contained trailer on the drill pad.

As plant and transmission line construction begins for the proposed action, construction worker requirements would increase. By the second year of construction, about 75 workers would be required. During the third and final year of project construction, approximately 160 construction workers would be employed by the proposed action. This peak total would include approximately 120 construction workers at the proposed plant site, 10 to 15 drilling personnel, and 25 to 30 transmission line construction workers.

All construction work would be performed under multiple construction contracts. Calpine intends to use local labor where appropriate for project construction. During

the summer months in the construction period, construction contractors may establish temporary living quarters at the project construction sites for non-local labor, and local labor would be expected to commute to the project area from their residences in the project region. If they desire, local labor may choose to avail themselves of the temporary living quarters provided by the construction contractors at the construction sites.

During the winter months, Calpine would keep an access route open to the plant site. This route would follow Forest Road 15 and 44N01 and 44N64, and would allow members of the construction crews (both local and non-local) to travel off-site from construction areas during the winter. However, some construction workers may live in temporary quarters on-site due to severe weather conditions. These workers may work in two-week shifts during the winter, with two weeks on-site and a corresponding time period off-site.

Operations Personnel: The power plant would be staffed by an estimated 19 persons, as follows:

- Plant manager
- Plant engineer
- Operations supervisor
- Secretary
- Chemist
- Electrician
- Instrument/control technicians (3)
- Roustabouts (2)
- Operators (6)
- Utility/equipment operators (2)

The plant would be staffed by two operators on shift including one relief operator. The relief operator would be available for part of the day shift, as well as for part of the night shift, primarily for trouble shooting and abatement assistance. Calpine's existing organization would provide management, reservoir engineering, geology, land, environmental and general administrative support.

It is anticipated that the staff would remain on-site for entire rotations. The operations staff (each team of three) would be rotated on a seven-day basis with 12-hour work shifts. The remaining staff would have a four-day Monday through Thursday rotation with a 10-hour work shift. Dormitory facilities would be provided for off-hours with sufficient provisions for a two-week period. In the event of a major storm during the rotation, a sno-cat would be maintained on-site to transport on-site workers out, and to bring in the next shift of operational workers. Otherwise, road access would be maintained by plowing and snowblowing equipment to ensure that operational workers could safely access and egress the plant site.

Decommissioning Personnel: Since project decommissioning activities are expected to be similar to project construction activities, the same number of maximum workers would be expected to be required during the decommissioning phase as during the construction phase. Up to 160 workers could be required for project decommissioning during the expected three-year decommissioning phase.

Economic Benefits

The proposed action would provide economic benefits through three means:

- Increased employment
- State and county property tax payments
- Royalty payments to the Federal government, with percentage returns to the state and county

Increased Employment: As discussed above, the proposed action would employ a peak of 160 construction workers during the 33-month construction phase, about 19 full-time employees during the 45-year operation phase, and an estimated peak of about 160 workers during the three-year decommissioning phase. Calpine intends to use local labor where appropriate for project construction, operation, and decommissioning. For the purposes of this analysis, it is assumed that approximately half of the construction, operation and decommissioning workforce for this project would come from the local labor pool. Salaries for construction workers would be dependent on salary negotiations with the selected construction contractors, and it is not possible to estimate expected salaries for these workers at this time. The estimated total of salaries that would be paid to operational employees is expected to be approximately $1.2 million per year (Calpine 1996).

Property Tax Payments: Another economic benefit of the proposed action would be the payment of state and county property taxes, which would generate revenues for the State of California and Siskiyou County. Estimated annual property tax payments for the project are based on the expected total capital cost of the project, as well as projected future cash flows. While the total capital cost can be projected with some certainty, future cash flows are largely a function of electricity revenues (i.e., the price of electricity), and can fluctuate widely depending on market conditions. It is expected that initial revenues to the state and county from property taxes would be approximately one percent of the total capital cost of the project, or about $1.3 million per year. The proposed project would be expected to generate these revenues for the state and county during the first five years of the project, after which revenues from property taxes would be expected to gradually decline. Over the first 20 years of the proposed project, it is projected that the total property tax payment to the state and county would be approximately $20 million (Calpine 1996).

Royalty Payments: The third economic benefit of the proposed action would be the payment of royalties to the Federal government for development of a geothermal resource, with percentage returns to the state and county. Similar to property tax payments, royalty payments for the project would be dependent on the expected total capital cost of the project and the price of electricity sold by the project. Based on cost projections for these items, the estimated total royalty payment to the Federal government over the first 20 years of the project would be between $15 and $25 million (Calpine 1996).

Under the current royalty system, 50 percent of the royalties paid to the Federal government are returned to the State of California. The state is then responsible for returning 40 percent of the royalties that it receives to the county where the power production from the geothermal resource would occur (in this case, Siskiyou County).

Based on the total expected royalty payment to the Federal government over the first 20 years of the project, the state would be expected to receive an estimated $7.5 to $12.5 million from project royalty payments during the first 20 years of the project. Of this total, the state would provide an estimated $3 to $5 million (40 percent of the royalty payments sent to the state) over the 20-year period to Siskiyou County. On an annual basis, the estimated royalty payments that would be received by the county would be expected to be approximately $50,000 to $300,000 during the first 20 years of the project (Calpine 1996).

2.3 Alternatives to the Proposed Action

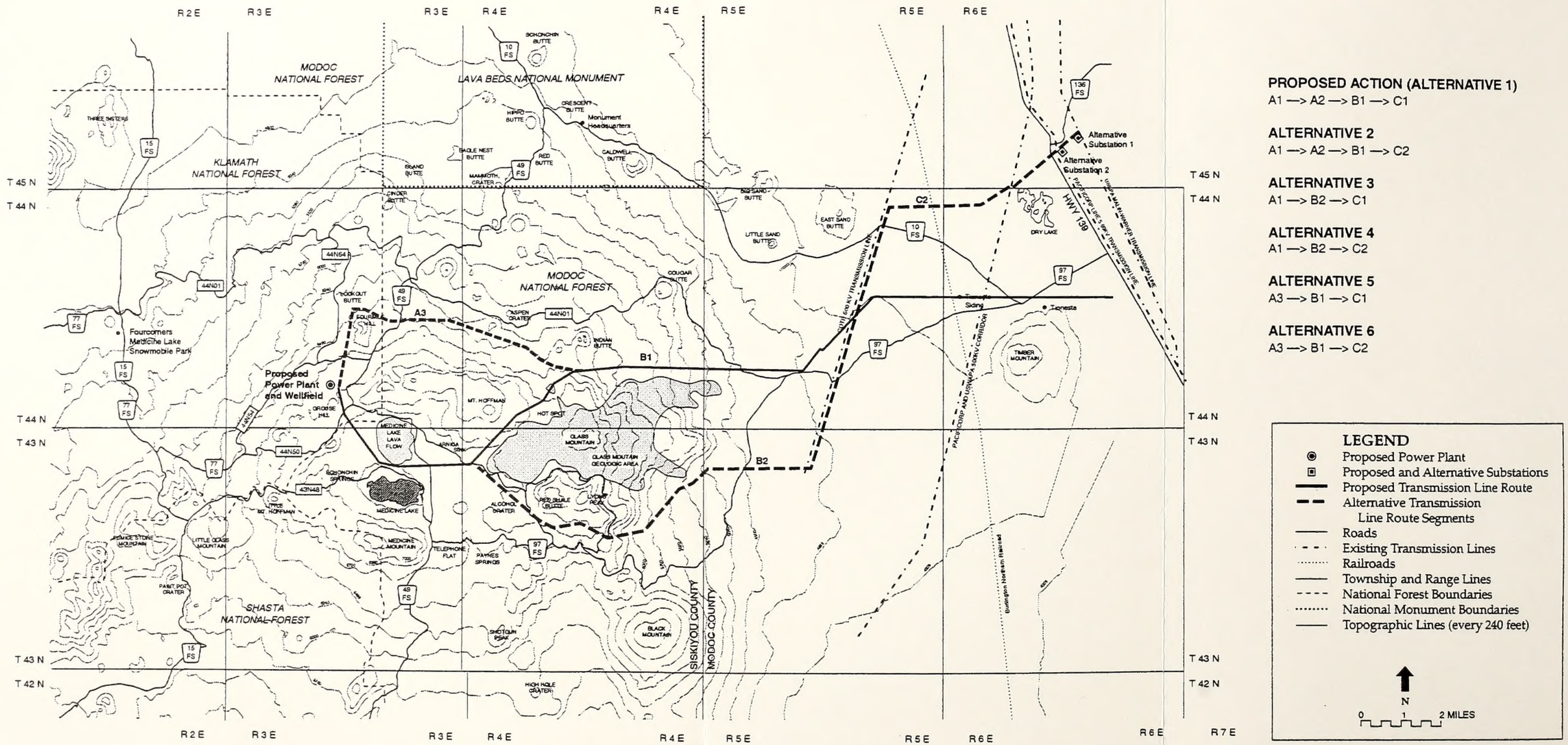
OVERVIEW

The alternatives to the proposed action considered in detail in this EIS/EIR include five alternate transmission line routes (designated as Alternatives 2 through 6), and the No Action alternative (designated as Alternative 7). Figure 2.3-1 illustrates the location of each of Alternatives 2 through 6, as well as the proposed action (Alternative 1). These alternatives provide a range of route alignments to transmit power from the power plant to the existing transmission line grid in the region. The five alternate routes to the proposed project have been designed to minimize or avoid effects to environmentally sensitive areas, such as recreational uses and sensitive plant communities at Medicine Lake, American Indian sites in the vicinity of Medicine Lake and Timber Mountain, and residential uses at Tionesta. The five alternatives are also considered to be technically feasible and reasonable from a cost perspective. Under the No Action alternative (required by both NEPA and CEQA), the Fourmile Hill Geothermal Development Project would not be implemented, and the resulting environmental effects from implementing the proposed project would not occur.

As discussed in Section 2.1, feasible alternatives to the proposed action are limited to alternate transmission line routes, and no alternatives for the proposed power plant and wellfield are available. The power plant and wellfield have been sited to minimize environmental effects, and the number of well pads and size of the proposed power plant and project components represent the minimum necessary for a feasible project. No feasible alternative siting or configuration of power plant and wellfield facilities is available to further reduce or avoid environmental effects (see the discussion of alternatives considered but rejected from detailed evaluation in Section 2.5).

Another reason that there are no feasible alternative locations for the proposed geothermal power plant and wellfield is because of the need for these facilities to be at a precise location in relation to the geothermal resource. Calpine has conducted geologic and geophysical studies that have identified the approximate drilling locations on their leases that are expected to offer the highest probability of encountering the geothermal reservoir fractures and a commercially viable resource when utilized. The identification of only one feasible location for the power plant and wellfield is consistent with alternatives consideration discussed in the CEQA Guidelines, which identifies proposed action, and Table 2.3-2 identifies which route segments are included in which alternative.

Figure 2.3-1: Proposed and Alternative Transmission Line Segments



PROPOSED ACTION (ALTERNATIVE 1)
A1 —> A2 —> B1 —> C1

ALTERNATIVE 2
A1 —> A2 —> B1 —> C2

ALTERNATIVE 3
A1 —> B2 —> C1

ALTERNATIVE 4
A1 —> B2 —> C2

ALTERNATIVE 5
A3 —> B1 —> C1

ALTERNATIVE 6
A3 —> B1 —> C2

LEGEND

- Proposed Power Plant
- Proposed and Alternative Substations
- Proposed Transmission Line Route
- Alternative Transmission Line Route Segments
- Roads
- Existing Transmission Lines
- Railroads
- Township and Range Lines
- National Forest Boundaries
- National Monument Boundaries
- Topographic Lines (every 240 feet)

N

0 1 2 MILES

Table 2.3-1: Alternative Transmission Line Route Segments

Segment Number	Segment Location	Length (Miles)
A3	Extends north from the power plant, passing west of Fourmile Hill, then heading southeast for approximately 5 miles southeast to the "matchpoint."	8.17
B2	Extends southeast from the eastern end of A1, then turns east passing to the south of Glass Mountain and Lyons Peak, and then turns to the northeast along the COTP 500-kV transmission line.	12.74
C2	Extends northeast along the COTP 500-kV transmission line, then turns east and then northeast, following the alignment of road 44N32 and passing north of the Dry Lake Area.	9.66

SOURCE: G.E. Raleigh and Associates, Inc. 1997; MHA Environmental Consulting, Inc. 1997

The design and engineering characteristics of each transmission line alternative would be similar to that described for the proposed route (see the description of the transmission line in Section 2.2). The only exception relates to the overall length and extent of access road construction required for each alternative, which varies depending upon the extent to which existing roads can be used. Table 2.3-3 identifies the total surface disturbance that would occur under each alternative. The following provides a description of the routing of each alternative transmission line route.

Alternative 2

Alternative 2 consists of segments A1, A2, B1, and C2. This alternative is a slight variation of the proposed transmission line route that uses essentially the same route as the proposed action, except that it uses segment C2 (which passes near Dry Lake) instead of C1. Segment C2 passes approximately 2 miles north of C1, and is located further from the community of Tionesta than C1. Segment C2 extends approximately 4 miles northeast along the existing COTP transmission line corridor to a point east of East Sand Butte (see Figure 2.3-1). The route then turns east and then northeast, generally following the alignment of road 45N32 and passing just north of the Dry Lake area. This alternative route would intersect with the BPA Malin-Warner transmission line at one of the two alternative substation locations that have been identified at the eastern terminus of the segment C2 transmission line (see Figure 2.3-1). Both of the alternative substation sites are located approximately five miles northwest of the proposed substation location. Only one of the alternative substations would be constructed.

The total transmission line length would be approximately 24.8 miles under Alternative 2, which is approximately 1.4 miles longer than the proposed route, as shown in Table 2.3-2. However, this route would require construction of 23.9 miles of new access roads, which is approximately 2.8 miles less than for the proposed action. This reduced need for new access road construction would be due to the greater access provided by existing roads for Alternative 2.

Table 2.3-2: Alternatives and Corresponding Transmission Line Route Segments

Alternative	Segments [1]	Length (miles)
Proposed Action (Alternative 1)	A1, A2, B1, C1	23.4
Alternative 2	A1, A2, B1, C2	24.8
Alternative 3	A1, B2, C1	25.7
Alternative 4	A1, B2, C2	27.1
Alternative 5	A3, B1, C1	23.2
Alternative 6	A3, B1, C2	24.6
Alternative 7	No Action	0.0

Notes:

[1] These segment designations correspond with the route segment designators shown on Figure 2.3-1.

SOURCE: G.E. Raleigh and Associates, Inc. 1997 and MHA Environmental Consulting, Inc. 1997

Table 2.3-3: Total Surface Disturbance by Alternative (in acres)

Alternative	Wellfield and Power Plant Area [1]	Transmission Line ROW	Transmission Line Access Roads	Intertie Substation	Total Acreage
Proposed Action (Alternative 1)	49.7	244.6	91.2	3.0	388.5
Alternative 2	49.7	246.4	84.7	3.0	393.8
Alternative 3	49.7	279.3	83.0	3.0	415.0
Alternative 4	49.7	281.1	76.5	3.0	410.3
Alternative 5	49.7	241.3	82.0	3.0	376.0
Alternative 6	49.7	243.1	75.6	3.0	371.3
Alternative 7	0.0	0.0	0.0	0.0	0.0

Notes:

[1] Includes the acreage for the water line from Arnica Sink.

SOURCE: G.E. Raleigh and Associates, Inc. 1997 and MHA Environmental Consulting, Inc. 1997

Alternative 3

Alternative 3 consists of segments A1, B2, and C1 (see Figure 2.3-1). This alternative follows segment A1, as for the proposed transmission line route, then heads southeast along segment B2. Segment B2 extends southeast for about a mile, generally following the alignment of road 43N53. It then turns east and southeast for about 5 miles, passing to the south of Glass Mountain and Lyons Peak. The route then turns due north for approximately a half mile, skirting the southeastern side of Glass Mountain, where it turns due east following the Modoc National Forest Boundary for about 4 miles. The route then turns northeast and follows the existing COTP transmission line corridor until it intersects with Segment B1. This alternative then follows segment C1 to the north of Tionesta, similar to the proposed transmission line route, to a connection with the BPA Malin-Warner transmission line at the proposed substation site.

The total transmission line length would be approximately 25.7 miles under Alternative 3, which is approximately 2.3 miles longer than the proposed route, as shown in Table 2.3-2. However, this route would require construction of approximately 25 miles of new access roads, which is approximately 1.7 miles less than for the proposed action. While segment B2 is longer than A2 and B1 combined, it would require less road construction to access the route due to the ability to use more existing roads for access under Alternative 3 than under the proposed action.

Alternative 4

Alternative 4 consists of segments A1, B2, C2 (see Figure 2.3-1). This alternative is the same as Alternative 3, except that it follows segment C2 (which passes near Dry Lake) instead of C1. Similar to Alternative 2, this alternative route would intersect with the BPA Malin-Warner transmission line at one of the two alternative substation locations at the eastern terminus of the segment C2 transmission line; only one of these alternative substations would be constructed. The total transmission line length of this alternative would be approximately 27.1 miles, which is approximately 3.7 miles longer than the proposed route, as shown in Table 2.3-2. This alternative route is the longest of all the alternatives proposed, including the proposed route. However, this route would require construction of 22.2 miles of new access roads, which is approximately 4.4 miles less than for the proposed route.

Alternative 5

Alternative 5 consists of segments A3, B1, and C1 (see Figure 2.3-1). From the power plant, this alternative follows segment A3 north for approximately 3 miles, on the western flank of Fourmile Hill. Segment A3 then wraps around the north side of Fourmile Hill and heads east-southeast for approximately 5 miles, to a point just south of Indian Butte. From this point, this alternative follows the same alignment as the proposed transmission line route along segments B1 and C1 to a connection with the BPA Malin-Warner line at the proposed substation site.

The total transmission line length would be approximately 23.2 miles under Alternative 5, which is approximately 0.2 miles shorter than the proposed route, as shown in Table 2.3-2. This route would require construction of 24.4 miles of new access roads, which is approximately 2.2 miles less than for the proposed action.

Alternative 6

Alternative 6 consists of segments A3, B1, and C2 (see Figure 2.3-1). This alternative is the same as Alternative 5, except that it follows segment C2 instead of C1. Similar to Alternative 2, this alternative route would intersect with the BPA Malin-Warner transmission line at one of the two alternative substation locations at the eastern terminus of the segment C2 transmission line; only one of these alternative substations would be constructed. The total transmission line length would be approximately 24.6 miles under Alternative 6, which is approximately 1.2 miles longer than the proposed route, as shown in Table 2.3-2. However, this route would require construction of 21.7 miles of new access roads, which is approximately 5 miles less than for the proposed route.

Alternative 7

As discussed above, Alternative 7 would be the No Action alternative. Under this alternative, the Fourmile Hill Geothermal Development Project would not be implemented, and the resulting environmental effects from implementing the proposed action would not occur.

2.4 Comparison of Alternatives

This section of the EIS/EIR presents the impacts of the proposed action and the alternatives in comparative form and to a comparable level of detail, pursuant to 40 CFR 1502.14 and CEQA Guidelines Section 15126(d)(3). This section also discusses the consideration of the lead agencies' "preferred alternative" in accordance with 40 CFR 1502.14(e), as well as the "environmentally superior alternative," as discussed in CEQA Guidelines Section 15126(d)(4) and the "environmentally preferable alternative," as discussed in 40 CFR 1505.2(b).

ALTERNATIVES COMPARISON

NEPA's implementing regulations state that an EIS should present the effects of the proposed action and the alternatives in comparative form, and to a comparable level of detail, to define the issues and provide a clear basis for decision-making by the lead agency and the public (40 CFR 1502.14). In addition, Section 15126(d)(3) of the CEQA Guidelines suggests that the project alternatives be presented in a matrix format to allow a comparison of the effects of the alternatives.

In conformance with both NEPA and CEQA, Table 2.4-1 provides a comparative analysis of the potential effects for key issues for all seven of the project alternatives, including the proposed action. Key issues are those issues that were identified as being of significant concern during the public scoping process for the project (see Section 1.6). Table 2.4-1 identifies the potential for effect for the proposed action, and compares the level of impact of each alternative to the proposed action, after implementation of defined mitigation.

In Table 2.4-1 (as well as throughout this EIS/EIR), a distinction is made between "effects," "adverse effects," and "significant adverse effects." Effects are changes in the environment that would occur as a result of the project but that would not be adverse

Table 2.4-1: Comparison of Key Issues for Alternatives [1]

Environmental Effect [2]	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Hydrology							
Effects to Medicine Lake water quality	A	A	A	A	A	A	N
Effects to Medicine Lake water quantity	N	N	N	N	N	N	N
Effects to regional water quality or quantity	N	N	N	N	N	N	N
Geothermal Resources							
Effects on regional thermal features	N	N	N	N	N	N	N
Cultural Resources							
Effects to historic or archaeological resources	E	E	E+	E	E+	E	N
Traditional Cultural Values							
Surface effects on traditional cultural sites	N	N	N	N	N	N	N
Effects on access to traditional sites	N	N	N	N	N	N	N
Effects on traditional cultural values	S	S+	S	S+	S-	S+	N
Effects on traditional cultural uses	S	S+	S	S-	S-	S-	N
Vegetation							
Effects of vegetation removal	A	A+	A+	A+	A-	A-	N
Effects to special status plant species	A	A	A	A	A	A	N
Effects to old growth Forest (late seral areas)	A	A	A+	A+	A	A	N
Wildlife							
Effects to general wildlife habitat	A	A+	A+	A+	A-	A-	N
Effects to special-status species (northern spotted owl, northern goshawk, bats)	A	A	A+	A+	A-	A-	N

Table 2.4-1: Comparison of Key Issues for Alternatives, continued

Environmental Effect[2]	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Visual Resources							
Effects of transmission line crossings of visually-sensitive roads	A	A	A+	A+	A-	A-	N
Effect on views from Medicine Lake	S	S	S	S	A	A	N
Effect on views from Tionesta and vicinity	A	A-	A-	A-	A	A-	N
Effect on views from Lava Beds National Monument	A	A	A	A	A	A	N
Plans and Policies							
Disturbance of released roadless areas	A	A	N	A	N	A	N
Land Use and Recreation							
Effects on Medicine Lake recreation and residences	A	A	A	A	N	N	N
Effects on snowmobiling	A	A	A	A	A	A	N
Air Quality							
Construction dust (PM_{10}) effects at Medicine Lake	A	A	A	A	A-	A-	N
Construction dust (PM_{10}) effects at Tionesta	A	N	A	N	A	N	N
Power plant emissions	A	A	A	A	A	A	N
Noise							
Construction and operation noise effects at Medicine Lake	S	S	S	S	A	A	N
Construction noise effects at Tionesta	S	N	S	N	S	N	N

Notes:

[1] This table focuses on the effects of key issues, as identified through the scoping process for the project.

[2] N = No effect; E = Effect; A = Adverse effect
A- = Adverse effect less than the proposed action
A+ = Adverse effect greater than the proposed action
S = Significant adverse effect
S- = Significant adverse effect less than the proposed action
S+ = Significant adverse effect greater than the proposed action

SOURCE: MHA Environmental Consulting, Inc. 1997

and would not be significant under CEQA. Adverse effects are effects that would occur as a result of the project, but that would be less-than-significant under CEQA.

Significant adverse effects are effects of the project that would be significant under CEQA. In comparing alternatives to the proposed action, a "+" sign is used in Table 2.4-1 for those effects that would be greater than the proposed action, and a "-" sign is used for effects that would be less than the proposed action.

LEAD AGENCIES' PREFERRED ALTERNATIVE

At the issuance of the Draft EIS/EIR, the lead agencies had not identified a preferred alternative. NEPA requires that the lead agencies identify a preferred alternative (40 CFR 1502.14(e)). Based on the evaluation contained in the Draft EIS/EIR and public and agency comment on the Draft EIS/EIR, the lead agencies have identified Alternative 6 as their preferred alternative. This alternative would use transmission line segment A3 instead of segments A1 and A2 proposed as part of the proposed action, and segment C2 instead of segment C1 (see Figure S-1). Segment A3 would be routed north from the proposed power plant to avoid the Medicine Lake area, and segment C2 would be located in the vicinity of Dry Lake to avoid passing near Tionesta and Timber Mountain.

ENVIRONMENTALLY PREFERABLE ALTERNATIVE

Of the alternatives under consideration in this document, implementation of the No Action alternative would result in the avoidance of the environmental effects that would occur under the proposed project and the other alternatives. The No Action alternative would therefore be considered the environmentally preferable alternative; however, the No Action alternative would not meet the purpose and need for the proposed action.

Pursuant to CEQA Guidelines Section 15126(d)(4), an environmentally superior alternative must also be identified from among other project alternatives in the EIS/EIR. Based on the analysis contained in Chapter 4 of this document and summarized in Table 2.4-1, Alternative 6 would be considered the environmentally superior alternative from among the project alternatives, other than the No Action alternative. Alternative 6 would have the least overall effect on the environment of these alternatives, because it would:

- Avoid construction of the transmission line near Medicine Lake and the associated visual, recreation, noise, and air quality effects at this location
- Minimize effects to traditional cultural values and uses (specifically, to avoid effects near Medicine Lake and Timber Mountain)
- Minimize vegetation disturbance, including tree disturbance, late seral forest removal, and potential effects to habitat for sensitive plant species
- Minimize effects to wildlife habitat, including sensitive species such as northern spotted owl, northern goshawk, and bats
- Avoid transmission line construction next to the community of Tionesta

2.5 Alternatives Considered But Eliminated From Detailed Study

The lead and cooperating agencies have considered various alternatives for the project throughout the EIS/EIR process, including evaluation of issues raised in the scoping process and during the development of the EIS/EIR. Calpine also considered a variety of alternatives in developing its proposal. Some of these alternatives are not considered in detail in this EIS/EIR because they would not meet the purpose and need, would be beyond the scope of this analysis, have been considered in another EIS or Environmental Assessment (EA), would not be technically feasible, or would have greater adverse environmental effects than would the proposed action or the alternatives already under consideration. Alternatives that were considered but not given detailed study in this EIS/EIR include:

- Alternate transmission line routes beyond those already under consideration
- Buried transmission line
- Smaller transmission line capacity
- Alternate power plant and wellfield locations
- Smaller power plant and wellfield facilities
- Buried wellfield pipelines
- Alternative geothermal power technologies

This section of the EIS/EIR summarizes those alternatives that have been considered but eliminated from detailed study, and are therefore not carried through in the environmental analysis in this document.

ALTERNATE TRANSMISSION LINE ROUTES

During the preliminary siting phase for the transmission line, Calpine considered a variety of possible transmission line routes from the proposed power plant site. In order to have a feasible project, the transmission line would need to connect to an existing transmission line and feed into the regional power grid. Calpine investigated the feasibility of transmission lines running north, west, south, and east from the plant site. As discussed in Section 2.2, the only feasible routes for the transmission line would head in an easterly direction from the power plant. These routes would provide a connection to an existing power line of the same capacity (230 kV) as the proposed transmission line within 20 to 25 miles from the proposed power plant site.

Possible routes in other directions were considered but eliminated from detailed consideration because they would require excessive surface disturbance, would impact environmentally sensitive areas, or would be too costly. The following discussion summarizes the consideration of possible transmission line routes in other directions, as well as transmission line routes to the east, that were considered but rejected.

Northern Routes

In a northerly direction, there are existing electrical facilities and systems that could serve as an endpoint for a transmission line from the proposed project. These facilities include the Malin Substation, the Captain Jack Substation, and Keno Dam. However, in order to access these facilities, the transmission line would need to cross through or in close proximity to the Lava Beds National Monument. National Park Service staff at the

Monument have stated that the transmission line for the project should not significantly affect the recreational experience at the monument. By placing the transmission line through or in close proximity to the Monument, the line could significantly affect views in the Monument. The Monument is also a Class I airshed, and construction activities could temporarily degrade the air quality at the Monument. These types of effects occurring directly at the Monument would be expected to adversely affect the recreational experience at the Monument.

In addition to potential visual and air quality effects at the Monument, a transmission line route heading in a northerly direction could cross the Tule Lake and Lower Klamath Wildlife Refuges. These refuges contain large wetland areas and serve as critical waterfowl habitat, and construction of a transmission line through this area would be expected to result in adverse effects to large areas of wetlands and wildlife species. This area is also a prime location for bird watching, and is a primary destination spot for visitors to the region. A transmission line through these refuges would be expected to detract from the recreational experience for these visitors. For these reasons, alternative transmission line routes heading north from the proposed power plant site were rejected from detailed consideration.

Western Routes

To the west of the proposed power plant site, the closest existing transmission line is PacifiCorp's Line 14, which is located approximately 50 miles to the west of the plant site. Due to its length, development of a transmission line in this direction would result in much greater surface disturbance and associated impacts than the proposed action. In addition, the PacifiCorp line is only a 115-kV transmission line, which would not be compatible with the proposed 230-kV line. A connection from the proposed transmission line would require an expensive transformer that would render this alternative infeasible. For these reasons, this alternative was rejected from detailed consideration.

The closest connection to an existing 230-kV facility is located at PacifiCorp's COPCO No. 2 Dam on the Klamath River, which is located approximately 60 miles to the northwest of the power plant site. Similar to a connection to PacifiCorp's Line 14, this alternative would result in much greater surface disturbance and associated impacts than the proposed action. A transmission line route in this direction would cross large areas designated for retention of visual quality objectives and more mountainous terrain (which would result in a more costly line). Development of this alternative would also affect several critical habitat areas, and would cross cultivated, agricultural land. For these reasons, this alternative was rejected from detailed consideration.

Southern Routes

The closest existing transmission lines to the south are the Pacific Northwest-Southwest 500-kV Interties, PG&E's Round Mountain 500-kV substation, and the COTP 500-kV transmission line. These 500-kV electrical systems would not be compatible with the proposed 230-kV line for the Fourmile Hill project. The construction of either a 500-kV transmission line or a 230-kV/500-kV substation are not economically viable alternatives, due to the cost of 500-kV transmission line construction (two to five times that of 230-kV construction); the cost of a 230/500-kV substation (ten times that of the

proposed 230-kV substation). In addition, the amount of electric power that would be delivered from Fourmile Hill project is relatively low, and would not justify the construction of a 500-kV transmission line. The connection of the proposed project to an existing 500-kV transmission line could also potentially degrade the reliability of the 500-kV line.

Eastern Routes

Several transmission line route options have been identified in the easterly direction from the Glass Mountain KGRA. These alternate routes were identified primarily by either Calpine or CalEnergy, a geothermal company that holds geothermal leases in other portions of the Glass Mountain KGRA. This EIS/EIR addresses those transmission line route options that would minimize effects to sensitive environmental areas, such as old growth habitat, special status wildlife species habitat, recreational areas, special geologic areas (e.g., glass and lava flows) areas with high visual quality, and released roadless areas (see Sections 2.2 and 2.3 for a description of these routes). Topographic features and constraints between the proposed Fourmile Hill plant site and BPA Malin-Warner line (the closest existing 230-kV transmission line connection) were also taken into consideration during the definition of easterly routes.

Several easterly routes were considered but eliminated from detailed consideration due to the potential for greater environmental effects than the alternatives currently under consideration. The following discussion identifies eastern alternative transmission line routes proposed by Calpine that have been considered but rejected from detailed evaluation in this EIS/EIR, and summarizes the treatment of eastern routes proposed by CalEnergy.

Calpine Routes: During the preliminary planning stages for the project, Calpine had identified a possible transmission line segment that extended almost directly east from the proposed Fourmile Hill power plant site along the southern Flank of Mount Hoffman. This alternate segment then connected into segment A2, approximately one mile southwest from the junction of segment A2, A3, and B1 (see Figure 2.3-1). This route passed through areas of high visual sensitivity (see Sections 3.9 and 4.9, Visual Resources), as well as habitat for several special status animal species. In addition, this alternative would affect a greater area of the Mount Hoffman released roadless area than the proposed route, and Mount Hoffman has been identified as a sensitive area for American Indians (see Sections 3.6 and 4.6 for a discussion of tribal concerns and traditional cultural values). Since this alternative would pass through more remote and undisturbed areas, more access roads would be required for a transmission line in this area than for alternate transmission line routes in the vicinity. This route would therefore have greater environmental effects than any of the alternative routes under consideration in the vicinity. For these reasons, this alternative was rejected from further consideration in this EIS/EIR.

Calpine had also identified a possible transmission line segment that extended almost due northeast from the proposed power plant site to a connection with segment A3 directly east of Fourmile Hill at the border of the Klamath and Modoc National Forests (see Figure 2.3-1). This alternate segment would pass through an area of high visual sensitivity (see Sections 3.9 and 4.9, Visual Resources). Due to the proximity of this

alternate segment to Forest Road 49 and the alignment of this segment along Forest Road 49, this route had the potential for greater effects to visual quality due to views from this road than the other alternatives. This alternate segment would also potentially affect the Fourmile Hill Tree Molds Special Interest Area (SIA) since the segment passes directly this SIA (see Sections 3.2 and 4.2, Geology and Soils). This route would therefore have greater environmental effects than any of the alternative routes under consideration in the vicinity. For these reasons, this alternative was rejected from further consideration in this EIS/EIR.

CalEnergy Routes: Easterly transmission line routes were identified by CalEnergy in their preliminary POU for the Telephone Flat Geothermal Development Project (CalEnergy 1996). The routes extended from the proposed CalEnergy plant site in the Telephone Flat area (approximately two miles east of Medicine Lake) to a connection with the BPA Malin-Warner line. The proposed Telephone Flat POU was submitted to the BLM for their consideration in July 1996, and was subsequently revised to eliminate several of the transmission line routes identified by CalEnergy (see Section 4.17—Cumulative Effects for a more detailed discussion of CalEnergy's Telephone Flat proposed project, and the potential cumulative effects of this project in combination with the proposed Fourmile Hill project).

The lead agencies have considered CalEnergy's alternate transmission line routes for suitability and viability for the proposed Calpine Fourmile Hill project in order to ensure a comprehensive evaluation of alternative eastern routes. One of the CalEnergy routes essentially follows the same route as the proposed Fourmile Hill transmission line from approximately Arnica Sink to a connection with the BPA Malin-Warner transmission line near Perez. This route is therefore being evaluated in detail in this EIS/EIR. In addition, another route proposed by CalEnergy that would travel south of the Glass Mountain Geologic Area has served as the basis for the alternative segment B2 for the Fourmile Hill transmission line (see Figure 2.3-1).

CalEnergy also identified a transmission line option that would extend east from the Medicine Lake Highlands south of Timber Mountain to a connection with the BPA Malin-Warner transmission line. This route would cross a significant portion of the existing 24,700-acre Damon Butte released roadless area directly south of Timber Mountain, and the USFS has directed that such a crossing would not be consistent with its management directive for the Damon Butte released roadless area. As opposed to the area north of Timber Mountain, there are currently no transmission line facilities in this area, and a line through this area would be readily apparent and would have a greater visual effect than a line north of Timber Mountain. A route through the Damon Butte released roadless area would also add four miles to the length of the transmission line in comparison to the proposed transmission line route, and would therefore result in greater surface disturbance. For these reasons, this alternative has been considered but rejected from detailed consideration in this EIS/EIR.

CalEnergy's revised POU includes two "tap" lines to the Fourmile Hill project that would only be constructed if the proposed Fourmile Hill project is approved and constructed (CalEnergy 1997). One of these tap lines would head directly north from CalEnergy's proposed Telephone Flat plant site to a connection with segment A2 of the proposed Fourmile Hill transmission line. The other tap line would head directly east

from the Telephone Flat plant site to a connection with alternative transmission line segment B2 (see Section 4.17—Cumulative Effects for more information on these tap lines). Since these tap lines are not complete transmission lines that provide a connection to an existing transmission line and the regional power grid, these lines are not considered in detail in this EIS/EIR.

BURIED TRANSMISSION LINE

The potential for using buried transmission lines has been raised by the public. An underground system was not considered in detail by Calpine, as the cost would be prohibitive. Construction-related environmental impacts from underground transmission systems in wooded, rocky terrain would generally be greater than for conventional overhead systems.

Underground transmission systems were reviewed by the Eugene Water and Electric Board as part of the initial analysis of the Newberry Geothermal Pilot Project in Deschutes County, Oregon, and the results of this review were presented in the EIS for the Newberry Project (USFS et al. 1994). The results of the review of underground transmission systems are summarized below.

- Installation requires that a continuous path be cleared for the cable trench. This often causes greater environmental impacts than an overhead line.
- Estimated construction, operation and maintenance costs for an underground cable are significantly higher than for an equivalent overhead system. Vaults for splicing and cable pulling are required every 1,000 to 1,500 feet and must be kept clear for maintenance.
- Underground transmission circuits are normally used in congested urban settings in larger metropolitan areas. Rural applications are rare and are not considered to be as cost-effective as overhead.
- Cable faults on underground systems require more time to locate and repair than with overhead circuits. The systems owner is generally required to maintain significant surplus cable for replacement since manufacturing time is long.
- Complete installation costs for an underground 230-kV transmission circuit are estimated at several times the cost of equivalent overhead circuits. Installation in wooded Forest areas with rocky conditions, access limitations, and additional travel time would further increase costs.
- Highly trained personnel are required for installation, including make-up of splices and terminations. Some utilities are beginning to use a solid dielectric cable that is also large in diameter, limited in flexibility, and requires specially trained personnel for installation.

Operation and maintenance costs for underground systems are significantly higher than equivalent overhead systems. Winter conditions at the project area would make repair maintenance exceptionally difficult and time consuming. Down-time would be extended and that could significantly impact the on-line time of the power plant.

Present technology has not developed materials or methods to efficiently and economically allow higher voltage electric transmission lines to be placed underground. The methods now used for underground construction are eight to ten times the cost of overhead construction with significantly greater costs of operation and maintenance. Although underground electric transmission lines are becoming more common in

congested, urban environments, they are seldom used in a rural or remote setting. The environmental impacts resulting from underground electric transmission line construction in mountainous, forested terrain would be considerable greater than that for an overhead transmission line.

There are three principal cable constructions which are used for high voltage cable applications. These are High Pressure Fluid Filled (HPFF), Self Contained Fluid Filled (SCFF), and Solid Dielectric (SD). HPFF has been the predominant cable installed in the United States for high voltage applications, while in Europe SCFF has been the more common selection. Although SD cables are becoming more common particularly at the 115/138-kV voltage levels, the use of SD cable is not practical for a 230-kV transmission project. SCFF cable would be the likely type of cable used for this project.

Many of the impacts associated with underground transmission cable systems are due to the actual trenching operation. The installation of underground transmission cable would create significant construction impacts to Forest lands and riparian environments. The soil conditions throughout the project area are reasonably consistent. Generally there is a relatively thin layer of soil on top of bedrock. The rock is primarily volcanic basalt or lava with large air voids. Due to the shallow depth of the top soil, the cable would be installed in the rock. The most cost effective method of construction would be excavation by blasting, although backhoes, rock drills, and/or rock saws would also be used.

A cable trench six to ten feet wide and six feet deep would be required for installation of the cables. The cables would be buried at a depth of four feet with two feet of controlled thermal backfill above, below, and to the side of the cables. It would be necessary to install this thermal backfill in order to counteract the high thermal resistivity of the native rock. The thermal backfill would be a Fluidized Thermal Backfill (FTB) consisting of a lean concrete mix with a specially selected aggregate. The cables would be installed in ducts to allow for removal if necessary. Standard stone backfill would be used for the balance of the trench above the thermal backfill.

A permanent right-of-way approximately 50 feet in width would be required for the underground transmission cable. All trees and brush would need to be removed from both the 50-foot-wide permanent right-of-way and an additional 25- to 50-foot-wide construction strip on either side of the permanent right-of-way. The construction strip would be used for trench spoils storage and access during construction. The permanent right-of-way would not be revegetated, and trees and brush would be prevented from growing within the permanent right-of-way during the life of the project.

The use of the right-of-way would be limited due to the requirements for safe operation and maintenance of the transmission line. Underground cable systems, other than solid dielectric cable, require above-ground equipment to provide proper cooling of the underground conductors due to the heat that is created when electricity flows through the line. The cooling equipment is located above ground and creates visual and noise impacts.

Although underground systems are not affected by adverse weather conditions, failures can occur with underground systems from internal or external causes. Some failures are difficult to locate and repair and require time consuming excavation and re-installation

of cable sections. If cables are damaged, gas or oil leaks can develop, potentially impacting water quality. When there is a requirement for maintenance on underground electric transmission lines due to physical damage or a fault on the line, excavation is required to locate the cable damage. In an area like the Medicine Lake Highlands that can receive 15 to 20 feet of snow during the winter, problems with a buried transmission line would be extremely difficult to locate. The high cost and the problems associated with outages are the primary reasons that electric transmission lines are seldom placed underground. The restoration of electric service caused by outages on underground electric transmission lines would take days as compared to hours for restoration on an overhead transmission line.

For all of these reasons, an underground transmission system will not be given detailed study in this EIS/EIR.

SMALLER TRANSMISSION LINE CAPACITY

The transmission line voltage of 230 kV was selected to accommodate potential future development in the Glass Mountain KGRA. This voltage would also allow the proposed transmission line to connect directly to the 230-kV Malin-Warner transmission line. Lower voltages were considered but rejected because:

- Lower voltages have higher line losses of electricity.
- Operation and maintenance costs would be higher if the voltage of the project transmission line differs from the 230-kV Malin-Warner transmission line with which it would connect.
- The lower voltage may not adequately accommodate future development.
- The environmental impacts would not be reduced by implementation of a lower voltage transmission line.

ALTERNATE POWER PLANT AND WELLFIELD LOCATIONS

Alternative locations for the proposed geothermal project are limited to:

- Areas under lease to the proponent
- Areas with the known geologic probability of encountering the geothermal reservoir fractures through vertical or directional drilling
- Areas that can accommodate the proposed facilities (plant, wells, pipelines) with sound environmental and engineering practices

In determining a location for a geothermal power plant and associated wellfield, it is necessary to conduct geologic mapping, temperature gradient well drilling and sampling, and geochemical and geophysical studies to identify the geothermal reservoir. The existence of a commercial reservoir is ultimately fully identified through drilling wells that encounter and produce geothermal fluids, and testing the flow from the wells to ensure commercial production can be sustained. The exploration programs necessary to prove the existence of a geothermal reservoir capable of commercial electrical production can cost $5 to $10 million. The process to identify alternatives to geothermal development is similar to that for mining projects; alternative locations without a demonstrated ore body are not considered reasonable or feasible alternatives.

Because the cost of identifying a commercial geothermal reservoir is very high (wells can cost several million dollars each), significantly different locations for power plants are not usually considered unless the geothermal field is large and well defined. Power plant location alternatives generally are located within approximately one mile of discovery wells (BLM et al. 1995).

As discussed in Section 2.1, no feasible alternative locations for the geothermal power plant and wellfield proposed by Calpine are available. The power plant and wellfield have been sited to minimize environmental effects, and the number of well pads and size of the proposed power plant and project components represent the minimum necessary for a feasible project. No feasible alternative siting or configuration of power plant and wellfield facilities is available to further reduce or avoid environmental effects.

As discussed above, the lack of feasible alternative locations for the proposed power plant and wellfield is due largely to the need for these facilities to be at a precise location in relation to the geothermal resource. Previous geologic and geophysical studies in the project area, as well as Calpine's own geothermal exploration activities, have provided an indication of the location and extent of the geothermal reservoir (this information is considered to be proprietary by Calpine). The power plant was sited in the only location that allows reasonable access to the geothermal resource and that is under lease to Calpine. The well pads were sited at the approximate drilling locations on Calpine leases that are expected to offer the highest probability of encountering the geothermal reservoir fractures and a commercially viable resource when utilized. Within this limitation, the well pads and power plant were sited to take maximum advantage of existing roads and surface disturbance, to minimize additional surface disturbance, and to consider environmental and engineering constraints.

An alternate project location will not be given detailed study in the EIS/EIR because there is no other feasible location for consideration that would support a commercially viable power plant and meet the stated purpose and need (see the discussion of development of project alternatives in Section 2.1). This approach is consistent with CEQA Guidelines Section 15126(d)(5)(B)(2), which identifies geothermal power plants as an example of a project for which there can be no feasible alternative location.

SMALLER POWER PLANT AND WELLFIELD FACILITIES

During the development of the design for the proposed power plant and wellfield, various options were considered for the production capacity of the proposed project and the size of the power plant and wellfield. These facilities were reviewed to determine if it would be feasibly possible to reduce their production capacity or size.

A reduction in the production capacity of the proposed project would not significantly minimize or avoid any environmental effects. The sizing of project facilities would not be affected by reduced production capacity. The proposed well pads are the minimum size necessary to contain well drilling and operation equipment and facilities, and the same equipment and facilities would still need to be present regardless of the project's production capacity. The same situation exists with the proposed power plant. The proposed size of the plant site is the minimum needed to contain necessary equipment and facilities, and the same equipment and facilities (of approximately the same size)

would still need to be present regardless of the project's production capacity. While a reduced production capacity could result in the need for fewer cooling tower cells (and hence a smaller cooling tower), this would not appreciably reduce the size of the power plant site required for the geothermal power plant and ancillary facilities.

A reduced production capacity could result in the need for a slightly fewer number of well pads and less use of the geothermal reservoir than currently proposed. However, the elimination of some well pads and the reduction in geothermal reservoir use would not significantly minimize or avoid any environmental effects. The proposed well pads and associated pipelines would occupy approximately 20 acres. While a reduced production capacity may eliminate one or two well pads and associated pipelines (equivalent to about 6 acres of disturbance), this reduction would not substantially minimize or avoid effects since the well pads and associated pipelines have already been sited to avoid significant environmental resources. In addition, there would still be use of the geothermal reservoir even with a reduced production capacity. While a reduced production capacity may reduce the rate of use of the reservoir, no environmental effects would be minimized or avoided.

Besides environmental considerations, a reduced production capacity would render the Fourmile Hill project financially infeasible. Calpine has proposed a production capacity of 44.9 MW (net) for the project, which is the minimum necessary for Calpine to implement a feasible project. A lower production capacity would result in the need for Calpine to charge a higher per unit rate for the energy that is produced by the power plant in order to recover development and operational costs. In general, geothermal energy currently has a higher cost than other energy sources, such as natural gas or coal. Any factor that would drive the per unit rate for geothermal power even higher than current conditions would severely affect the ability of the project to compete with these other energy sources, and may render the project financially infeasible. If the production capacity of the power plant were reduced and Calpine could not charge a higher per unit rate, then Calpine would consider the project to be infeasible from an economic standpoint, and the project would not be built.

A reduction in the size of the proposed power plant and wellfield is also not feasible if the project is to have a net production capacity of 44.9 MW. As discussed above, the number and size of the well pads and the size of the proposed power plant represent the minimum necessary for a feasible project with the necessary production capacity. In addition, the power plant and wellfield have been sited to minimize environmental effects.

BURIED WELLFIELD PIPELINES

The idea of buried production and injection pipelines for the project was considered during the planning stages of the project. However, buried pipelines were rejected from detailed consideration due to the potential effects to subsurface resources from this alternative, and the substantially increased costs. Construction and maintenance of buried pipelines would be far more difficult and costly than surface pipelines, with increased environmental effect due to increased surface disturbance.

ALTERNATIVE GEOTHERMAL POWER TECHNOLOGIES

There are several different technologies for tapping the energy from geothermal resources. The different types of geothermal power plants include binary, single-flash, double-flash, and pure steam technologies. Since each geothermal resource has unique characteristics, some technologies are not technically appropriate or feasible for a given location. Certain technologies were eliminated from further study either because they are not the most effective technology for the expected Fourmile Hill resource or because they are technically not feasible for the resources.

Binary Plant

Binary-cycle power plants are usually used to produce power from shallow, low temperature (less than 350°F) geothermal resources. Binary plants use geothermal fluids to heat a secondary fluid (usually a hydrocarbon such as isobutane or isopentane) that vaporizes at a lower temperature than water. Discovery Wells 68-8, 31-17, 87-13, 17A-6 on CalEnergy leases indicate that the resource temperature at Fourmile Hill will be above 350°F and is expected to include both steam and hot water. In a binary plant, the brine would have to be kept under pressure to keep it from flashing to steam. The additional electrical load from pumps, coupled with other considerations, indicates that a binary plant would be a technically inappropriate and energy-inefficient use of the geothermal resource at Fourmile Hill. Also, the hydrocarbons used in a binary plant create environmental concerns related to fugitive emissions and the transportation and storage of petrochemicals. Unless dry (fan-forced air) cooling is used, groundwater or surface water must be used in the condenser. Dry cooling imposes an additional electrical load on the plant, and is inherently less efficient because cooling efficiency (and therefore plant output) depends on ambient air temperature. Therefore, a binary plant will not be addressed in detail in the EIS/EIR. If, during exploration, resources are discovered which are suited to binary technology, then a new analysis will be prepared.

Single-Flash Plant

A single-flash plant would not be a feasible alternative because it would not optimize the use of the geothermal resource. In a double-flash plant, as proposed, the steam and hot water are separated at the well head, and the separated hot water is allowed to flash to steam at high pressure and again at a lower pressure. This double-flash process increases the amount of steam that can be extracted from the resource and therefore maximizes the amount of electricity that can be produced from a given volume of reservoir fluid. A single-flash plant would be less efficient in tapping geothermal energy than a double-flash plant, but would be expected to result in similar environmental effects. This alternative, therefore, will not be addressed in detail in the EIS/EIR.

Pure Steam Plant

A pure steam plant can only be used with a geothermal resource that produces only steam and no hot water. There is currently only one known dry-steam geothermal resource in the United States, at The Geysers in California, and only three other locations are known in the world. The geothermal resource at Fourmile Hill is not expected to be a dry-steam resource so this technology will not be addressed in detail in the EIS/EIR. Dry steam plants typically "consume" on the order of 80 percent of

geothermal fluid as evaporative loss in the cooling tower. This fluid is not available to replenish the reservoir. If, during exploration, resources are discovered which are suited to pure steam technology, then a new analysis will be prepared.

3: DESCRIPTION OF THE AFFECTED ENVIRONMENT

3: DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Introduction

This chapter of the EIS/EIR provides a description, by environmental parameter, of existing conditions in the vicinity of the proposed project. For each environmental parameter, the study area for that parameter is first described. The methodology for determining the existing conditions in the study area for the parameter is then identified. Where appropriate, a regional overview for the environmental parameter is then provided. This regional overview is followed by a discussion of the characteristics of the affected environment for the proposed action (Alternative 1). The characteristics of the affected environment for Alternatives 2 through 7 are then presented.

For Alternatives 2 through 6, the affected environment for the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. However, these alternatives would each have different transmission line routes; these routes would be comprised of the various transmission line segments described in Chapter 2. The descriptions of the affected environment for Alternatives 2 through 6 focus on those segments of the transmission line that would be different from those already described in the proposed action, or associated with previously described alternatives.

In this chapter of the document, various terms are used to describe the proposed project and surrounding areas. "Proposed action" and "proposed project" are used interchangeably, and refer to Alternative 1. When discussing the transmission line, particular transmission line segments are sometimes referenced (e.g., segment A1, segment A2, etc.). The "project area" and/or "project vicinity" refer to the general area in which the proposed project and alternatives are located.

3.2 Geology and Soils

DEFINITION OF STUDY AREA

The study area for the geology and soils analysis of the proposed project included the area encompassing the proposed power plant site, wellfield, and the proposed and alternative transmission line segments. These facilities extend approximately from Grouse Hill on the west to the Malin-Warner transmission line on the east (Figure 2.2-2).

METHODOLOGY

Preparation of the geology and soils analysis of this document was based on review and evaluation of the following materials:

- Geologic reference material on the Medicine Lake Volcano
- Soil surveys of the Klamath and Modoc National Forests
- The Klamath and Modoc Forest Land and Resource Management Plans (LRMPs)
- Environmental analysis documents prepared for earlier geothermal proposals within the Glass Mountain KGRA
- U.S. Geological Survey (USGS) topographic maps
- Aerial photographs of the power plant and wellfield area and the proposed and alternative transmission line routes

In addition, USFS personnel and other knowledgeable persons were consulted. A site reconnaissance of the power plant and wellfield area and the transmission line route was also conducted.

REGIONAL OVERVIEW

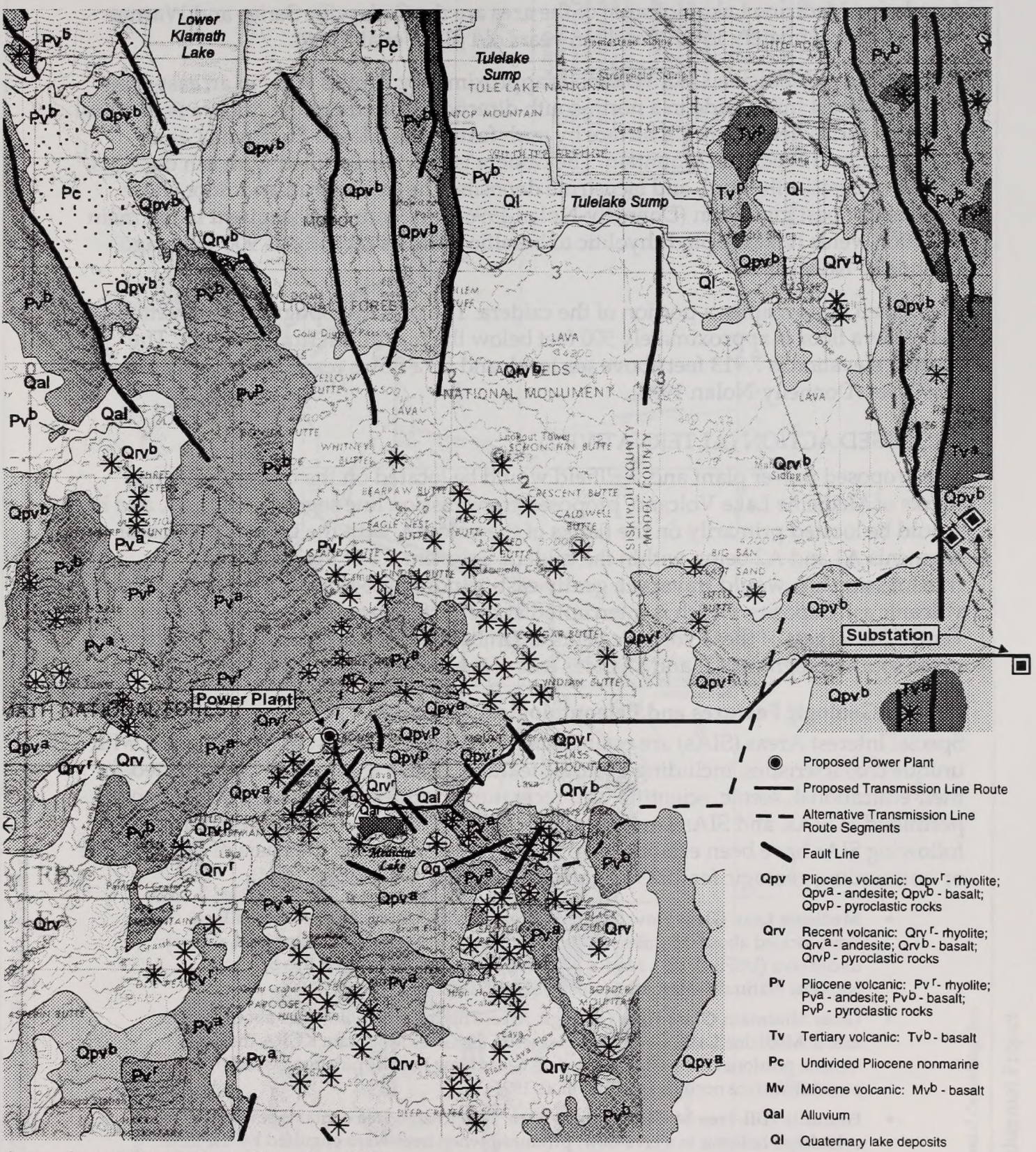
The project area is located along the boundary between the Cascades Range geomorphic province and the Modoc Plateau. The Cascades province is characterized by rhyolitic to basaltic volcanic activity. Volcanoes within the province include massive, steep-sloped stratovolcanoes (such as Mount Shasta), small cinder cones (such as Fourmile Hill), glass flows (such as Glass Mountain), and relatively low, gently sloping shield volcanoes (such as Medicine Lake Volcano). The more recently active volcanoes in the province include Lassen Peak and Mount Saint Helens.

The Cascade province is the result of subduction of the Gorda tectonic plate under the North American plate, which has created an arcuate line of volcanoes parallel to the subduction boundary. The province is seismically active compared to most parts of the U.S. However, it is considered to be one of the less active plate margins, experiencing only small to moderate earthquakes associated with subduction processes and/or the upward migration of magma. The general geology of the area is presented in Figure 3.2-1.

Medicine Lake Volcano

The Medicine Lake Volcano is a shield volcano approximately 25 miles in diameter (BLM et al. 1995). The topographic area encompassing Medicine Lake Volcano is also referred to as the Medicine Lake Highlands, and includes a central, downdropped caldera with numerous volcanic vents along the caldera rim and upper flanks. The volcano began erupting approximately 1 million years ago, and at least 17 eruptions

Figure 3.2-1: Regional Geology



Source: Geologic Map of California, Alturas Sheet (1968)

MHA *Environmental Consulting, Inc.*

have occurred over the past 12,000 years (Donnelly-Nolan 1990). Basement rocks (predating Medicine Lake Volcano) of the area are the Cedarville Series and Warner Basalts, approximately 15 to 30 million years old (BLM et al. 1995).

The caldera of Medicine Lake Volcano is approximately 7 miles wide in an east-west direction and 4 miles wide in a north-south direction. The rim of the caldera is elliptical in shape and is defined at the surface by such features as Mount Hoffman, Glass Mountain, and Medicine Mountain. The caldera is now partly filled with ash deposits, glacial deposits, alluvium, and lacustrine deposits. The caldera rim and floor show evidence of past glaciation (Donnelly-Nolan 1996, pers. com.). Subsequent to the main eruption, vents have erupted rhyolitic to basaltic lavas, as recently as 900 years ago (Donnelly-Nolan 1990).

Medicine Lake occupies a portion of the caldera. The present topographic elevation of the caldera floor is approximately 500 feet below the maximum rim elevation. The highest elevation is 7,913 feet above sea level, and lava flows reach elevations as low as 3,360 feet (Donnelly-Nolan 1990).

PROPOSED ACTION (ALTERNATIVE 1)

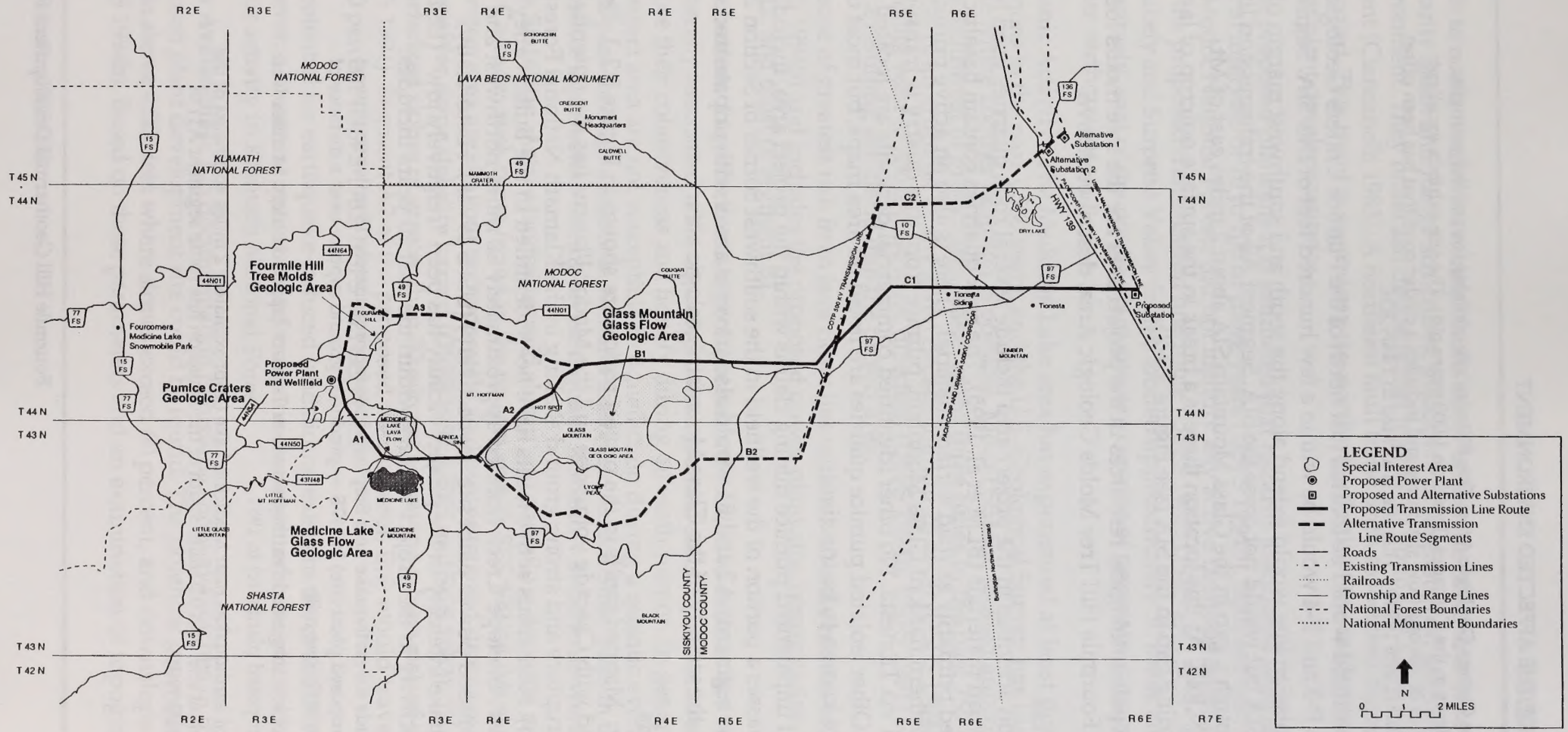
The proposed power plant and wellfield would be located on the upper northwest flanks of Medicine Lake Volcano, proposed transmission line segments A1, A2, and B1 would be located primarily on the flanks of the volcano, with the greater portion of segments A1 and A2 being within the caldera. Segment C1 of the proposed transmission line would traverse a gently east- to northeast-sloping plain, formed by volcanic ash deposits, which is interrupted at the surface by a few scattered volcanic vents. The largest of these volcanic vents is Timber Mountain, located approximately 2 miles south of segment C1 and 17 miles east of the proposed power plant site.

Unique Geologic Features and Paleontological Resources

Special Interest Areas (SIAs) are established by a National Forest to protect areas with unique characteristics, including geologic features. These areas are to be protected for their educational, scenic, scientific, and recreational values. Road construction is not permitted in SIAs, and SIAs are to be avoided in locating new utility corridors. The following SIAs have been established in the project vicinity on the basis of their unique or outstanding geologic features (Figure 3.2-2) (USFS 1991; USFS 1994):

- **Medicine Lake Glass Flow Geologic Area:** This 600-acre pancake-shaped lava flow, located about 0.5 miles north of Medicine Lake, is a good example of a glassy dacite lava (USFS 1994b). Modoc National Forest has nominated this SIA for National Natural Landmark Status (USFS 1991).
- **Glass Mountain Glass Flow Geologic Area:** This large lava flow lies about 2 miles east of Medicine Lake. Geothermal leases in the Glass Mountain KGRA that include portions of the Glass Mountain Glass Flow have stipulations which prohibit surface occupancy (BLM et al. 1995).
- **Fourmile Hill Tree Molds Geologic Area:** This 10-acre area contains several cylindrical hollows in a lava flow, produced when trees were engulfed by the flow. It is located about 4 miles north of Medicine Lake near the eastern boundary of the Klamath National Forest in T44N,R3E. It is the only known feature of its type in Klamath National Forest.

Figure 3.2-2: Geologic Special Interest Areas in the Project Vicinity



MHA *Environmental Consulting, Inc.*

SOURCE: USFS

- **Pumice Craters Geologic Area:** This 800 acre site contains four of the youngest glass flows in the Cascades (less than 1,000 years old). The site exhibits excellent examples of viscous flow structures and includes a cinder cone that has been offset by a fault (USFS 1994b). This site is located in T44N,R3E.

The proposed wellfield would be located just north of the Pumice Craters Geologic Area. Well pads P-3 and P-4 would be within a few hundred feet of this SIA. Segment A1 of the transmission line would extend along the south and southwest margin of the Medicine Lake SIA but would not cross the SIA. Segment A2 of the transmission line would cross through a gap in the Glass Mountain SIA about 2 miles east of Mt. Hoffman in T44N,R4E. At this location there is a break in the surface outcrop of lava and a corresponding gap in the SIA (see Figure 3.2-2).

The only known paleontological resources in the project area are the tree molds located in the proposed Fourmile Hill Tree Molds Geologic Area, described above.

Mineral Resources

Mineral extraction activities in the project area include several rock quarries used by the USFS to supply road materials (BLM et al. 1995). The rock quarries contain basaltic cinder that is used primarily as road surface material. There is also an active pumice quarry on the northern flank of Glass Mountain; pumice from this quarry is transported to Reno, Nevada via Tionesta. No other identified commercial deposits are located in the project area. Other isolated pumice quarries are noted on area maps, but most of these quarries are known to be inactive.

There are several unpatented pumice mining claims within the project area, including one that encompasses a portion of the wellfield in the southwest corner of Section 28. Transmission line segments A2 and B1 would also traverse areas with unpatented mining claims in the vicinity of the Glass Mountain geologic area.

Geologic Hazards

Seismic Activity: Mapped faults in the project region are shown in Figure 3.2-1. Fault activity associated with Cascade volcanoes and the Modoc Plateau has the potential to produce surface rupture and strong ground shaking in the Klamath National Forest area (USFS 1994b). Numerous active faults have been identified in the Butte Valley area, as well as one near Antelope Creek (located approximately 30 miles northwest and 11 miles west of proposed power plant site, respectively) (USFS 1994a). Historically, however, earthquake intensity in the project vicinity has been "relatively low" (USFS 1994b). Seismic activity in the project vicinity within the past 20 years includes:

- Magnitude 4.6 earthquake near Stephens Pass (approximately 15 miles southwest of the proposed plant site) in 1978 — produced ground rupture over a distance of approximately one mile
- Swarm of low magnitude earthquakes near Tennant (approximately 14 miles west of the proposed plant site) in 1981
- Swarm of earthquakes near Medicine Lake (approximately 2 miles southeast of the power plant site, and 0.5 miles south of transmission line route segment A1) in 1989 (USFS 1994b)

North to north-northwest normal faults occur across the Medicine Lake Volcano and are primarily Basin and Range structures, indicative of an east-west extensional environment. They offset ash deposits that may be as young as 1,100 years before present (Ciancanelli 1983). A northeast fault trend with associated alignment of vents is also noted. This trend is seen along the northwest flank of the caldera near the proposed power plant development site.

At the proposed plant site it is estimated that hazards associated with seismic events recur at intervals of 10 to 100 or more years (USFS 1994b). Soils surveys of the Klamath and Modoc National Forests did not identify any active faults or seismic activity on or near the proposed transmission line route (USFS 1982; USFS and SCS 1983). However, the Likely and Surprise Valley faults, located approximately 50 miles and 75 miles, respectively, east of the power plant site, are capable of generating magnitude 5 or greater earthquakes.

Volcanic Activity: The Medicine Lake area has experienced at least three volcanic eruptions in the past 1,500 years, and the U.S. Geological Survey has identified the area as one where another eruption is possible. Mount Shasta, located approximately 30 miles southwest of project area, has erupted three times in the past 750 years, and the chances of an eruption in any given decade are 1 in 25 or 30 (USFS 1994a). The prevailing west to southwest wind direction (USFS 1994b; USFS 1991) would probably blow a resulting ash cloud into the project area.

The zone of greatest risk from lava flows lies within a 10-mile radius of Medicine Lake (USFS 1994b) and includes the proposed power plant site, transmission line segments A1, A2, and most of segment B1.

Liquefaction: Liquefaction is a geologic hazard related to seismic activity. Liquefaction is generally associated with saturated coarse grained soils. When saturated, these soils can lose their cohesiveness and liquefy during an earth tremor. In general, the soils in the project area are not susceptible to liquefaction during a seismic event. Segment A1 would pass through a seasonal wetland area near Arnica Sink. Soils in this area could experience liquefaction during an earthquake if shallow sediments were saturated.

Slope Stability: Active landslides and slump and earthflow deposits are rare in the High Cascades rock types found in the project area (USFS 1994b). Most of the soils in the project area are shallow to moderately shallow, with good drainage and low potential for slope stability hazard (USFS 1982; USFS and SCS 1983). The USFS characterized slopes of greater than 30 percent as having a high risk of slope movement (USFS 1991). Segment A2 of the proposed transmission line would traverse slopes of 50 to 100 percent (USFS 1982; USFS and SCS 1983).

The potential for earthquake-induced landsliding exists in the area (USFS 1994b). However, a literature review found only one documented case of a rock slide caused by seismic activity in Klamath National Forest.

Snow Avalanches: No documentation of historic snow avalanches in the vicinity of the proposed plant development site could be found. The potential for avalanches exists in terrain above 4,000 feet where slopes exceed 60 percent, and downslope from such areas (USFS 1994b). Based on these parameters and an examination of topographic maps, a

portion of transmission line segment A2 would be located in an area with a low potential for snow avalanches (Calpine 1995; USFS 1982; USFS and SCS 1983).

Soils

Soils in the project area are almost exclusively of volcanic origin and have been derived from basalts, andesitic basalts, tuffs, ash-fall pumiceous material, rhyolites and mixed volcanic rocks. The soils are characteristically well- to excessively-drained, sandy loams that were formed by weathering and mechanical breakdown of extruded volcanic rocks. In many locations, soil has not had an opportunity to form, due to the relatively young age of the deposits and the relatively cool, dry climate.

Named soil families in the project area include Belzar-Wintoner, Inville-Wintoner, and Redcap-Stonewell. Soils found along the transmission line route east of Medicine Lake include the Alcot-Holland and Stone-Yallani-Inville families. All the soils in the project area are considered to be lower- to mid-elevation, dominantly woodland soils formed in relatively recent volcanic parent materials (USFS 1982). Dominant soil types at the power plant and wellfield and along the transmission line route are given in Table 3.2-1. Detailed information about the soil types can be found in the soil surveys for the Klamath and Modoc National Forests (USFS 1982; USFS and SCS 1983).

The permeability of a soil directly affects the amount of associated surface runoff, rate of groundwater recharge, and potential for soil erosion. The permeability of soils in the project area have been rated by either the relative rate of water infiltration or the relative runoff potential. The infiltration rate for a soil type is proportional to the rate of groundwater recharge and inversely proportional to the rate of surface runoff. Therefore, if a soil has a rapid rate of infiltration, it will have a low amount of runoff. Conversely, a soil with a high runoff potential will have a low infiltration rate.

Soils in the Klamath National Forest have been classified by the rate at which water infiltrates the soil from the surface (USFS 1982). Seven discrete qualitative values ranging from very slow to very rapid were defined. Soils in the Modoc National Forest have been classified according to the water runoff potential, defined as the relative velocity of surface water runoff (USFS and SCS 1983). Five discrete qualitative values were defined ranging from very rapid (very little water enters the soil, thus runoff will be high) to very slow (water enters the soil immediately, thus runoff will be low). Table 3.2-1 provides infiltration or runoff potential for soils at the power plant and wellfield area and along the proposed transmission line route.

Soil Erosion

The potential for soil erosion in the project area has been evaluated using two primary criteria presented in soil surveys completed for the Modoc and Klamath National Forests (USFS 1982; USFS and SCS 1983).

- **Soil-Erodibility Factor (K):** The K value is expressed for a specific soil type and represents that soil's physical capability to resist soil erosion. The value is based primarily on soil texture, structure, organic matter, rock fragments by volume, and permeability. K values typically range from 0.02 to 0.70. The higher the K value, the more susceptible a soil is to sheet and rill erosion by water (USFS 1982).

Table 3.2-1: Characteristics of Dominant Soil Units in the Proposed Project Area

Soil Unit Name	Project Facility/ Transmission Line Segment	Infiltration Rate or Runoff Potential	Erosion Hazard Rating (EHR)	Erosion Factor (K)
Power Plant and Wellfield Area		*Infiltration Rate*		
Belzar-Wintoner (104)[1] (2-15% slopes)	Power plant Wellfield	Moderately rapid to very rapid	Moderate	0.05
Belzar-Wintoner (105) (15-50% slopes)	Wellfield	Moderate to very rapid	Low to Moderate	0.15
Redcap-Stonewell (173)	Power plant Wellfield	Very rapid	Moderate	0.1
Cinder Lands (108)	Adjacent to the power plant	n/a[2]	n/a	n/a
Lava flows (152)	Adjacent to the power plant	n/a	n/a	n/a
Inville-Wintoner (146) (2-15% slopes)	Adjacent to the wellfield	Moderately slow to moderately rapid	Moderate	0.24-0.32
Transmission Line Segments		*Runoff Potential*		
Divers-LaPine (163)	A1	Slow to moderate (pumice), very rapid (outcrop)	Moderate to high	0.17-0.2
Kinzell-LaPine-Divers (193)	A1, A2	Very slow	Low to moderate	0.17-0.2
Divers-LaPine-Knizel (161) (2 to 30% slopes)	A2	Very slow to slow	Low to moderate	0.17-0.2
Divers-LaPine-Knizel (162) (30-55% slopes)	A2	Moderate	Moderate to high	0.17-0.2
Stonewell (260)	B1	Very slow	Moderate	0.15
Alcot (104) (1-10% slopes)	B1	Very slow	Low	0.15
Alcot (105) (5-35% slopes)	B1	Very slow	Low to moderate	0.15
Holland (182)	B1, C1	Very slow	Low	0.20
Castlevale-Wenatchee-Searles (140)	C1	Very slow	Low to moderate	0.20-0.24
Corwiche-Simpson (146)	C1	Slow	Low	0.37-0.43
Holland deep-Skalan 183)	C1	Very slow	Low	0.20
Keating-Deven (191)	C1	Moderate	Low to moderate	0.32-0.37
Pass Canyon-Los Gatos (228)	C1	Slow to moderate	Low to moderate	0.32
Menzel-Holland (246)	C1	Very slow to slow	Moderate	0.15-0.20
Supan-Supan (268)	C1	Very slow	Low to moderate	0.32

Notes:

[1] The number after each soil name is the map number used in the USFS soil survey. Numbers are not the same for the Klamath and Modoc surveys.

[2] n/a = not available

SOURCE: USFS 1982; USFS and SCS 1983

- **Erosion Hazard Rating (EHR):** A soil's erosion hazard rating is a qualitative rating expressed as either low, moderate, high , or very high. The EHR presents the risk for soil loss by accelerated sheet and rill soil erosion. The maximum rating is based on the assumption of little or no vegetative cover and a long-term average occurrence of 2-year, 6-hour storm events. Many interrelated factors are evaluated in an EHR system to determine whether accelerated erosion is likely to occur, among them being soil characteristics (including K factor), slope and length of slope, precipitation, and aspect.

Soil erosion potentials for soil units in the proposed project area are summarized in Table 3.2-1. In the portion of the power plant site where most of the facilities are to be located (i.e. power plant, pipelines, and well pads), the dominant soil units have low to moderate EHRs and K values ranging from 0.05 to 0.15 (USFS 1982). Soils along the proposed transmission line segments A1 and A2 have the highest erosion potentials, with EHRs ranging from low to high. EHRs along segment B1 vary from low to moderate. Along segment C1, K values range as high as 0.43; however, erosion potential along this segment is actually low, partially because of the relatively flat terrain.

ALTERNATIVES

As discussed at the beginning of this chapter, the following describes the affected environment for each alternative to the proposed action. For Alternatives 2 through 6, the affected environment for the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of the existing environment along these portions of the transmission line are not repeated under each alternative discussion. The description of the affected environment focuses on the segments of the alternative transmission line routes that would be different from those in the proposed action.

Alternative 2 (A1, A2, B1, and C2)

Under Alternative 2, transmission line segment C2 would replace segment C1. The affected environment for the power plant and wellfield area, and transmission line segments A1, A2, and B1 would be the same under this alternative as described above for the proposed action. The existing environment along segment C2 for geology and soils is described below.

Segment C2: Similar to segment C1, segment C2 would traverse a gently east- to northeast-sloping plain, formed by volcanic ash deposits, interrupted at the surface by a few scattered volcanic vents. Segment C2 would be outside of the zone of greatest risk from volcanic activity from Medicine Lake Volcano. Based on soil and topographic characteristics, this segment would not be susceptible to slope instability or snow avalanche. Segment C2 would pass north of Dry Lake, which is a seasonal wetland. Soils along this portion of the segment may contain saturated soils at certain times. However, the soils in this area are primarily very shallow, clay to clayey loams overlying basalts, and therefore are unlikely to be susceptible to liquefaction during an earthquake.

Characteristics of dominant soil types along segment C2 are listed in Table 3.2-2. The majority of soils along segment C2 have a low erosion potential with slow or very slow runoff potential.

Alternative 3 (A1, B2, and C1)

Under Alternative 3, transmission line segment B2 would replace segments A2 and B1. The affected environment for the power plant and wellfield area, and transmission line segments A1 and C1 would be the same under this alternative as described above for the proposed action. The existing environment along segment B2 for geology and soils is described below.

Segment B2: Alternative transmission line segment B2 would be located on the southeast flank of Medicine Lake Volcano, with a portion of it being within the caldera. Most of segment B2 would be within the zone of greatest risk for volcanic activity from the Medicine Lake Volcano. Based on the parameters described under the proposed action and an examination of topographic maps, a portion of transmission line segment B2 would be located in an area with a potential for slope instability and snow avalanches (Calpine 1995; USFS 1982; USFS and SCS 1983). This segment would not be susceptible to liquefaction.

Characteristics of dominant soil types along segment B2 are listed in Table 3.2-2. Soil along this segment have EHRs ranging from low to high with runoff potentials from very slow to moderate. In general, the soils along the steeper portions of this segment have higher ratings for erosion and runoff potential. Individual soil units along segment B2 just east of the Siskiyou/Modoc County line were not mapped in the Modoc National Forest soil survey.

Alternative 4 (A1, B2, and C2)

Under Alternative 4, transmission line segment B2 would replace segments A2 and B1, and segment C2 would replace segment C1. The affected environment for the power plant and wellfield area, and transmission line segment A1 would be the same under this alternative as described above for the proposed action. Existing conditions along segments B2 and C2 are described above under Alternatives 3 and 2, respectively.

Alternative 5 (A3, B1, and C1)

Under Alternative 5, transmission line segment A3 would replace segments A1 and A2. The affected environment for the power plant and wellfield area, and transmission line segments B1 and C1 would be the same under this alternative as described above for the proposed action. The existing environment along segment A3 is described below.

Segment A3: Alternative transmission line segment A3 would be located on the northern flank of Medicine Lake Volcano. This segment would not pass near any established or proposed geologic SIA. Segment A3 would be located within 10 miles of Medicine Lake which is considered the zone of greatest risk for volcanic activity from the Medicine Lake Volcano (USFS 1994b). Based on soil and topographic characteristics, this segment would not be susceptible to slope instability, snow avalanche, or liquefaction.

Table 3.2-2: Dominant Soil Units Along the Alternative Transmission Line Segments[1]

Soil Unit Name	Project Facility/ Transmission Line Segment	Runoff Potential	Erosion Hazard Rating (EHR	Erosion Factor (K)
Divers-LaPine-Knizel (161),[2] (2 to 30% slopes)	A3	Very slow to slow	Low to moderate	0.17-0.2
Inville-Yallani (186)	A3	Very slow to slow	Moderate to high	0.15-0.17
Kinzell-LaPine-Divers (193)	A3	Very slow	Low to moderate	0.17-0.2
Stonewell (26)	A3	Very slow	Moderate	0.15
Stonewell Yallani (262)	A3	Moderate	Moderate to high	0.2
Yallani-Inville (278)	A3	Slow	Low to moderate	0.15-0.17
Kinzell-LaPine-Divers (193)	B2	Very slow	Low to moderate	0.17-0.2
Divers-LaPine-Knizel (161) (2 to 30% slopes)	B2	Very slow to slow	Low to moderate	0.17-0.2
Alcot (104) (1-10% slopes)	B2	Very slow	Low	0.15
Holland deep-Skalan 183)	B2	Very slow	Low	0.20
Menzel-Holland (246)	B2	Very slow to slow	Moderate	0.15-0.20
LaPine-Divers (197) (20-40% slopes)	B2	Slow	Moderate	0.17-0.20
LaPine-Divers (198) (40-60% slopes)	B2	Moderate	High	0.17-0.20
Stonewell-Yallani (261) (5-30% slopes)	B2	Very slow to slow	Low to moderate	0.15
Stonewell-Yallani (262) (30-55% slopes)	B2	Moderate	Moderate to high	0.20
Alcot-Menzel (108)	C2	Very slow	Low	0.15
Castlevale-Wenatchee-Searles (140)	C2	Very slow	Low to moderate	0.20-0.24
Castlevale-Bakeoven (139)	C2	Slow	Low to moderate	0.24
Corwiche-Simpson (146)	C2	Slow	Low	0.37-0.43
Holland (182)	C2	Very slow	Low	0.20
Holland deep-Skalan (183)	C2	Very slow	Low	0.20
Pass Canyon-Los Gatos (228)	C2	Slow to moderate	Low to moderate	0.32
Menzel-Holland (246)	C2	Very slow to slow	Moderate	0.15-0.20
Stukel-Los Gatos- Pass Canyon (267)	C2	Very slow to moderate	Low to moderate	0.32-0.37

Notes:

1 Soils along segments A3 and A4 were not surveyed in either the Klamath or Modoc National Forest soil surveys.

2 The number after each soil name is the map number used in the USFS soil survey. Numbers are not the same for the Klamath and Modoc surveys.

SOURCE: USFS 1982; USFS and SCS 1983

Table 3.2-2 lists characteristics of dominant soil types along segment A3; however, soils along the western 2 miles of the segment were not surveyed by either the Klamath or Modoc National Forests. Soils along segment A3 have EHRs ranging from low to high with runoff potentials primarily in the slow or very slow range.

Alternative 6 (A3, B1, and C2)

Under Alternative 6, transmission line segment A3 would replace segments A1 and A2, and segment C2 would replace segment C1. The affected environment for the power plant and wellfield area, and transmission line segment B1 would be the same under this alternative as described above for the proposed action. Existing conditions along segments A3 and C2 are described above under Alternatives 5 and 2, respectively.

Alternative 7 (No Action)

The setting for Alternative 7, the No Action alternative, would be the same as for Alternatives 1 through 6.

3.3 Hydrology

DEFINITION OF STUDY AREA

The study area for the hydrologic analysis of the proposed project included the area encompassing the proposed power plant site, wellfield, and the proposed and alternative transmission line segments. These facilities extend approximately from Grouse Hill on the west to the Malin-Warner transmission line on the east. The analysis also evaluated regional hydrologic resources including those in the Klamath Lake and Tule Lake basins, Butte Valley, and along the Pit and Fall Rivers.

METHODOLOGY

A search of the GeoRef database was conducted to obtain information about hydrologic conditions in the project area. The search included the years 1975 to 1996, and looked for references on hydrogeology, hydrology, and groundwater using approximately 20 geographic search terms. Very few references for the project area were found through this database search. In addition, the database at Oregon Institute of Technology, Klamath Falls, Oregon was accessed for a listing of groundwater wells in the area. USFS, USGS, and Department of Water Resources references were also reviewed.

Other technical references reviewed as part of this analysis included the Water Quality Control Plans for the North Coast and Central Valley regions, soil surveys of the Klamath and Modoc National Forests, USGS topographic maps, and the Klamath and Modoc Forest LRMPs. Hydrologic data was provided primarily by Calpine staff and USGS data (Schneider and McFarland 1996). Environmental review documents prepared for earlier geothermal proposals within the Glass Mountain KGRA were also reviewed. In addition, USFS staff and other persons knowledgeable with the hydrology of the project area were consulted, including: Robert Christensen, Julie Donnelley-Nolan, and William McFarland of the USGS; Dr. Thomas Grose of the Department of Geology, Colorado School of Mines; and Dr. Timothy Rose of Lawrence Livermore Laboratory. A site reconnaissance of the power plant and wellfield area was conducted and aerial photographs of the transmission line routes were reviewed.

REGIONAL HYDROLOGY

The climate in the project area is characterized by warm, dry summers and cool, moist winters (USFS 1994b). The prevailing wind direction is from the southwest (USFS 1994b; USFS 1991b). Since most of Medicine Lake Volcano (hereafter called the volcano) lies at elevations higher than 4,000 feet above mean sea level (USGS 1984), the majority of the winter precipitation falls as snow (USFS 1994b), and surface water flow and groundwater recharge occur mainly during snowmelt in the late spring and early summer. Total precipitation for the area is estimated at 30 inches per year, based on measured precipitation at Garner Mountain (located approximately 11 miles west of the proposed power plant and wellfield area). Measurements of the water equivalent of the snow pack at Medicine Lake over the past twenty years also correspond to an annual precipitation rate of approximately 30 inches.

Despite the estimated 30 inches per year of precipitation at higher elevations, there is almost a complete lack of surface runoff in the Medicine Lake Highlands. No streams

that emerge in the highlands flow continuously across the lower slopes of the volcano to deliver water to the surrounding basins. The reason for this lack of surface drainage from the higher elevations is apparent from an examination of the volcanic deposits which form the surface of the volcano. These volcanic deposits consist of blocky, rubbly lava flows, discontinuous lava tubes, collapsed lava tubes, cinders, pumice, and glass flows. These materials are extremely permeable and are capable of absorbing large quantities of rainfall and snowmelt through the process of infiltration . Removal of water from the Medicine Lake Highlands is thus achieved through subsurface flow, evaporation, or plant transpiration.

Regional Drainage Basins

The proposed project would be located within two distinct primary drainage basins — the Central Valley and North Coast Basins. Medicine Lake Volcano is located on the divide between these two drainage basins (USFS 1991b; RWQCB 1994a). Most of the surface waters within the caldera and on the south side of the volcano flow to the Pacific Ocean via the Sacramento River and lie within the Central Valley Basin. Surface waters north of the caldera rim (roughly defined by the ridge that includes Grouse Hill and Mount Hoffman) drain to the ocean via the Klamath River and are within the North Coast Basin (RWQCB 1994b; USGS 1984). The proposed project would be located on the northwest side of the caldera rim, in the North Coast Basin.

Within the two primary drainage basins, the project study area includes several hydrologic units and subareas, as defined by the Water Quality Control Plans (also called Basin Plans) for the Central Valley and North Coast basins (RWQCB 1994a; RWQCB 1994b) (see Figure 3.3-1). The hydrologic units and subareas in the project region are listed in Table 3.3-1.

Regional Surface Waters

Medicine Lake is the largest body of water within 10 miles of the project area (see Figure 3.3-2); it is located approximately 3 miles south of the power plant site (USGS 1952). The lake lies at the topographic base of the Medicine Lake caldera, at an elevation of 6,676 feet above mean sea level. The lake appears to exist as a result of clayey glacial deposits that impede the vertical flow of surface water and act as a seal (Donnelley-Nolan 1996). Medicine Lake has a maximum depth of approximately 150 feet (Schneider and McFarland 1996). Temperature of lake water changes abruptly from approximately 58°F at depths shallower than 40 feet to 43°F or less below 40 feet.

The water quality of Medicine Lake was monitored by the USFS in 1971-2, 1982, and 1983, and by the USGS in 1992 (USFS 1984; Schneider and McFarland 1996). Each of these studies found the Medicine Lake water to have good clarity, low nutrient levels, and low buffering capacity (Table 3.3-2). Monitoring of oil, grease, and petroleum hydrocarbons in the lake found that all were below detectable levels.

Table 3.3-1: Hydrologic Units and Subareas in the Project Region

Hydrologic Unit	Hydrologic Subarea	Direction of Surface Drainage	Description
North Coast Basin			
Klamath River Hydrologic Unit	Mt. Dome	North to the Klamath River	Extends from the northwest margin of Medicine Lake to the Oregon border; includes Lower Klamath Lake and Lower Klamath National Wildlife Refuge; the power plant and wellfield would be located within this subarea
	Tule Lake	To the north	Extends from the northeast flank of Mt. Hoffman east to Timber Mountain and north to the Oregon border; includes Lava Beds National Monument and Dry Lake
	Clear Lake	To the north	Extends east from the eastern border of the Tule Lake subarea
Central Valley Basin			
Pit River Hydrologic Unit	Medicine Lake Crater	To the south	Encompasses the Medicine Lake caldera and the area to the south; includes Medicine Lake, Little Medicine Lake, and Arnica Sink
	Long Bell	To the south	Extends south from the southeast flank of Lyon's Peak and southwest flank of Timber Mountain

SOURCE: RWQCB 1994a; RWQCB 1994b

Table 3.3-2: Medicine Lake Water Quality Data [1]

Parameter	1971-1972	1982	1983
Turbidity	0.14-3.0 JTU [2]	0.3 JTU	0.3 JTU
Secchi Disc Depth [3]	n/a	287 in	307 in
Dissolved Oxygen	8.5 mg/l	7.5 mg/l	7.0 mg/l
Total Phosphorus	0.07 mg/l	0.018 mg/l	0.017 mg/l
Total Alkalinity	<17 mg/l	5.8 mg/l	5.9 mg/l
pH	6.7-7.4	7.4	7.0

Notes:

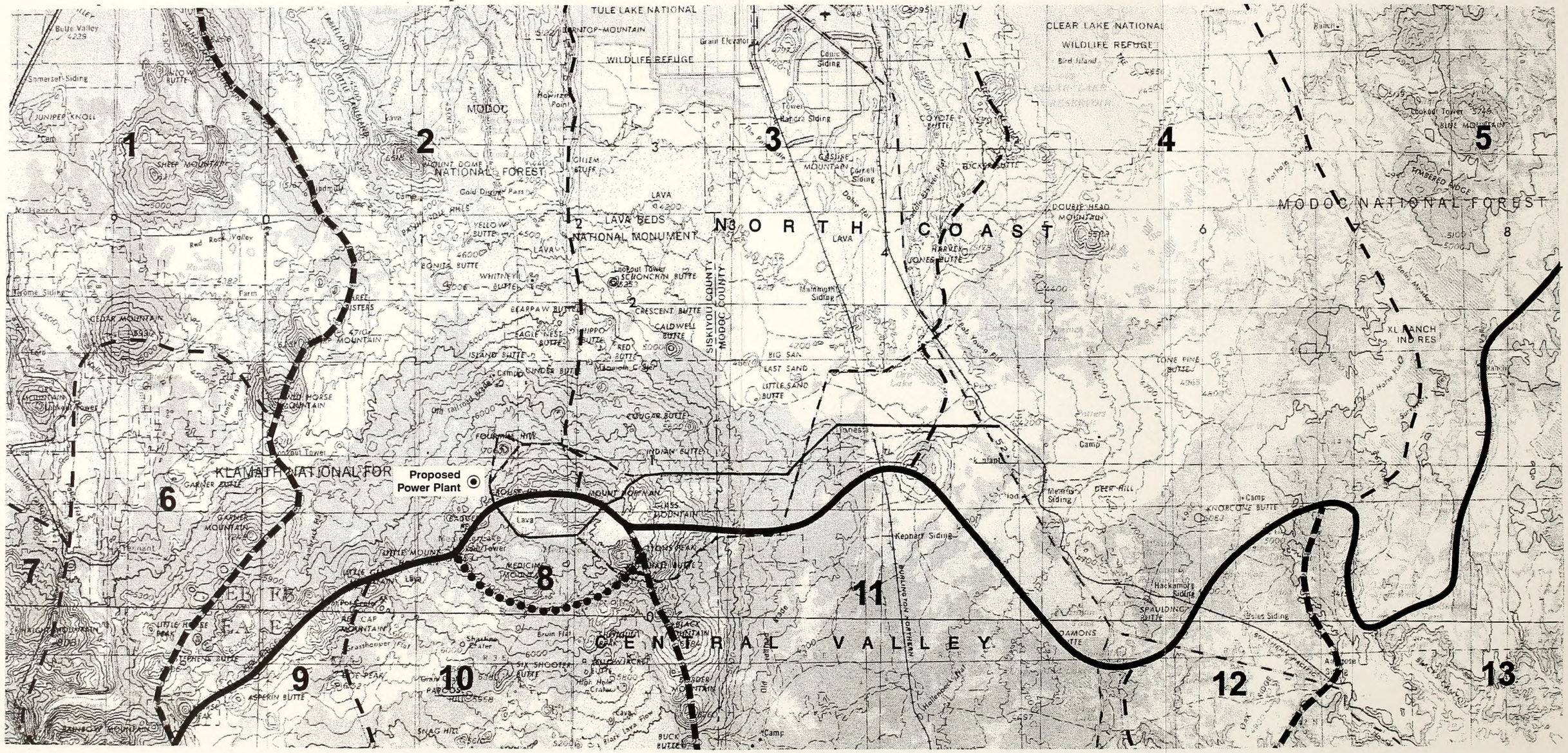
[1] Data are from water quality monitoring performed by the USFS in 1971, 1972, 1982, and 1983. Mean values are given unless only a range was reported.

[2] JTU = Jackson Turbidity Units, a measure of turbidity based on the amount of light-scattering caused by the water

[3] Secchi disc depth is a measure of water clarity.

SOURCE: Schneider and McFarland 1996

Figure 3.3-1: Regional Drainage Basins in the Project Vicinity



Legend

North Coast Basin

Klamath River Hydrologic Unit
- *Butte Valley Hydrologic Area*
  - 1 - Macdoel-Dorris
  - 6 - Tennant
  - 7 - Bray

Lost River Hydrologic Unit
- 2 - Mt. Dome
- 3 - Tule Lake
- 4 - Clear Lake
- 5 - Boles

Central Valley Basin

Pitt River Hydrologic Unit
- *McArthur Hydrologic Area*
  - 8 - Medicine Lake Crater
  - 9 - Pondosa
  - 10 - Medicine Lake
- *Big Valley Hydrologic Area*
  - 11 - Long Bell
  - 12 - Turner Creek
- *Upper Pitt River Hydrologic Area*
  - 13 - Big Sage

——— Proposed Transmission Line Route
- - - - Alternative Transmission Line Route Segments

Base Map: USGS - Alturas, Revised Date 1971, Scale 1:250,000

References:
RWQCB, Central Valley Region (5), Sacramento Hydrologic Basin Planning Area
Scale 1:500,000

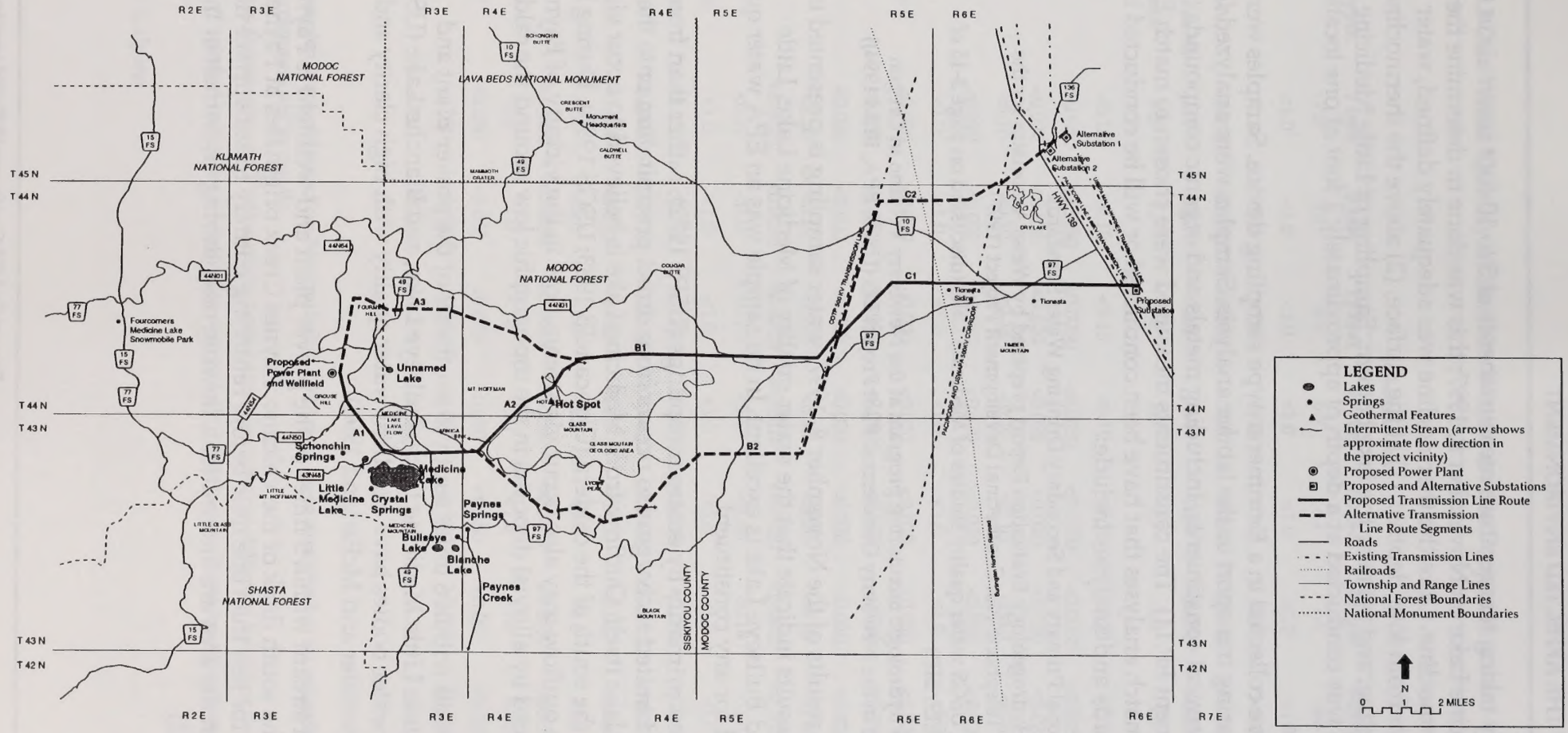
N

0 2.5 5 MILES

MHA *Environmental Consulting, Inc.*

SOURCE: USGS, RWQCB

Figure 3.3-2: Surface Waters in the Project Area



MHA *Environmental Consulting, Inc.*

SOURCE: USFS; USGS

Sampling began by taking temperature measurements at 5 to 10-foot intervals in three locations on Medicine Lake on November 8, 1997; this was done to determine the location of the thermocline. Once the thermocline was adequately defined, water samples were taken from four depths: (1) at the surface, (2) above the thermocline, (3) below the thermocline, and (4) near the lake bottom. Sampling of Little Medicine Lake and Bullseye Lake was conducted at a depth of approximately 1 foot at one location each.

Water samples were collected in a Kemmerer-type sampling device. Samples were preserved in ice during transport to the lab for analysis. Samples were analyzed for a wide variety of chemical constituents, including metals and organic compounds (as requested in comment FP.11). The constituents measured were chosen to match EPA standards and to match analyses that have been conducted or will be conducted in the area. These standards and analyses include:

- EPA National Primary and Secondary Drinking Water Standards
- Baseline Hydrogeology Evaluation Report prepared by Weiss Associates for the proposed Telephone Flat Geothermal Development Project (1997)
- USFS and USGS water quality studies of Medicine Lake (discussed on page 3-15 of the Draft EIS/EIR)
- The USGS hydrologic monitoring program at the Newberry Volcano in Oregon (described in the Newberry Geothermal Pilot Project EIS (USFS, BPA, BLM 1994))

A summary of the results of the November 8, 1997, water sampling is presented in Table 3.3-2a. The results indicate that the water quality of Medicine Lake, Little Medicine Lake, and Bullseye Lake is excellent. In no sample was an EPA water quality standard exceeded for any constituent.

Medicine Lake is fed primarily by emergent springs (USFS 1972), rather than from surface drainages. Limited recharge also occurs from direct precipitation onto the surface area of the lake itself. Outflow from Medicine Lake is believed to occur via Paynes Springs to the south of the caldera (Ciancanelli 1983; USGS 1995). During high lake levels, surface outflow may also occur via stream flow in the vicinity of Paynes Springs, as evidenced by alluvial deposits in the topographic low around the caldera rim.

Other nearby lakes, all within 6 miles south to southeast of the power plant and wellfield area, include Little Medicine Lake, Bullseye Lake, and Blanche Lake (USGS 1952). All of these water bodies have excellent water quality with high clarity and low nutrient levels (Schneider and McFarland 1996).

The only perennial stream within 5 miles of the power plant and wellfield is Paynes Creek located on the south flank of the volcano. Paynes Creek originates at Paynes Springs and flows for less than one mile before returning entirely to subsurface flow. All other streams in the area are intermittent, flowing only during snowmelt or intense rainfall (USGS 1952).

Table 3.3-2a: Water Quality of Surface Waters in the Project Area

	Medicine Lake							Little Med Lake	Bullseye Lake
Sample Depth	**1 foot**	**5 feet**	**15 feet**	**20 feet**	**30 feet**	**55 feet**	**60 feet**	**1 foot**	**1 foot**
pH	7.0[2]	7.1[2]	6.6	6.9[2]	7.1	7.1	6.8	6.8	6.9
Chloride	<1.0[3]	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sulfate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrate (as N)	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Ammonia (as N)	0.17[2]	0.17[3]	0.24	0.11[2]	0.29	<0.050	<0.050	<0.050	<0.050
Total Organic Carbon	1.3[2]	1.7[2]	1.8	1.9[2]	1.7	2.0	2.2	4.2	3.2
Antimony	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Beryllium	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Boron	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Calcium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.8	<1.0
Chromium	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Cobalt	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Copper	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Iron	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.17	<0.10
Lead	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Manganese	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Mercury	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.9	1.2
Vanadium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Zinc	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Strontium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Notes:

[1] All samples were obtained on November 8, 1997, and were analyzed at an accredited laboratory. All measurements are in mg/l.

[2] Value is the average of 2 to 3 surface water samples taken at different locations on Medicine Lake.

[3] The "<" symbol indicates a result that was below the detection limit for that particular constituent.

SOURCE: Calpine

Five springs are located within approximately 5 miles of the power plant and wellfield. Schonchin Spring, Crystal Springs, and an unnamed spring on the northwest shore of Medicine Lake are located within the caldera, 2 to 3 miles south of the proposed plant site. Paynes Springs is located approximately 5 miles south-southeast of the project area. Paynes Springs, which is actually a pair of springs, is the source of Paynes Creek. Tamarack Spring is located approximately 5 miles west of the proposed power plant and wellfield, on the northeastern flank of Garner Mountain (USGS 1984; Schneider and McFarland 1996).

Isolated springs are located on the lower flanks of Medicine Lake Volcano. In general, these springs represent surface outflow of shallow groundwater flow from snowmelt and winter precipitation.

Regional Groundwater

Data from water wells, geothermal wells, and springs in the project vicinity provided information on the groundwater system. Temperature gradient data and lithologic logs from geothermal wells in the area indicate that there are two distinct groundwater systems, a shallow, cold groundwater aquifer and the geothermal system. The shallow, cold groundwater supplies water for the non-geothermal wells in the area, including those used for domestic supply. The geothermal system and its relation to the cold, shallow groundwater are discussed in Section 3.4, Geothermal Resources.

The shallow groundwater occurs within permeable volcanic deposits and fractured volcanic rocks in the shallow subsurface and is recharged primarily by infiltration of local snowmelt into the permeable volcanic material during the late spring and early summer. A lesser component of recharge comes from infiltration of rainfall during summer and fall. Waters percolating into the subsurface descend until reaching the top of the water table (i.e., the top of the saturated zone). At this point, the vertical, downward flow of water is impeded and water movement is dominated by lateral flow in response to the hydrologic gradient.

The base or lower surface of the water table occurs where the permeability of the aquifer diminishes to the extent that all water movement is impeded. This decrease in permeability may be an original characteristic of the formation, such as a clay-rich matrix in a sedimentary rock. Decreased permeability may also develop in an initially permeable rock. Mineral deposition in pore spaces and fractures along with weathering and alteration of the original rock to clay minerals serve to effectively reduce permeability. In general, these mechanisms are aided by depth of burial, increasing age of the formation, and exposure to geothermal heat and fluids.

The base of the shallow groundwater aquifer in the Medicine Lake Highlands coincides with a thick section of impermeable rocks which underlie the lavas and cinders which comprise the aquifer. These impermeable rocks (a prominent member of which in the Fourmile Hill area is a clay-rich, ash-flow tuff) isolate the shallow groundwater system from the geothermal system (see Section 3.4, Geothermal Resources, for a more detailed discussion of this separation). Within the caldera, the lithologic sequence consists of collapsed layers of volcanic deposits and glacial deposits, bounded by a ring fracture system (Ciancanelli 1983). Shallow groundwater within the caldera is probably

separated for the most part from the shallow groundwater outside the caldera by the ring fracture system.

Data suggest that regional groundwater flow directions are roughly the same as those for the surface waters. Groundwater elevations for the area in the immediate vicinity of Medicine Lake indicate radial flow away from the Medicine Lake caldera in the shallow groundwater system (Figure 3.3-3). Shallow groundwater within the caldera appears to flow toward the center at a very shallow gradient, and probably discharges at the southern portion of the caldera through Paynes Springs into Paynes Creek. It is assumed that through the surface flow in Paynes Creek, water from within the caldera is able to overflow the subsurface barrier formed by the ring fracture system and drain to the south.

Several groundwater basins exist in the region surrounding Medicine Lake, including the Mt. Dome/Klamath Lake, Tule Lake, and Butte Valley areas to the north and Fall River to the south (Figure 3.3-4). The power plant and wellfield area are located within the Mt. Dome/Klamath Lake groundwater basin which supports limited agriculture and ranching. The Tule Lake basin is located to the northeast and also supports limited agriculture and grazing. Butte Valley, to the northwest, supports extensive agriculture and relies heavily on groundwater for irrigation. The headwater springs for the Fall River are located approximately 35 miles to the south-southeast of Medicine Lake and provide the Fall River area with a high volume, near-constant water source with high water quality characteristics. These basins are described in greater detail below.

Mt. Dome/Klamath Lake: The Mt. Dome/Klamath Lake groundwater basin extends from the northwest section of the caldera rim northwards into the Lower Klamath Lake lowland area. It roughly corresponds to the Mt. Dome hydrologic subarea and is bounded by Garner, Wildhorse and Mahogany Mountains to the west and by Sheep Mountain, Barntop Mountain and Gillem Bluff to the east (Figure 3.3-3). The Lower Klamath National Wildlife Refuge, Lower Klamath Lake, Willow Creek, and various other smaller bodies of surface water are located in the northern, lower-lying portions of the basin.

Groundwater recharge to this basin comes from shallow groundwater on the northwest flank of the volcano, flowing radially away from the caldera. Additional recharge comes from seepage loss from perennial streams and unlined canals. In the highlands, the shallow aquifers are primarily fractured basalt flows that extend throughout the lower flanks of Medicine Lake volcano. Approximately 5 to 10 miles north of the power plant and wellfield area, the main volcanic edifice merges into the Lower Klamath Lake basin which is a northwest trending, downfaulted valley with a low, flat valley floor. Shallow groundwater within this subarea is likely to be constrained to flowing in a northwest direction, parallel to this strong structural trend, and is therefore unlikely to either cross or underflow the subarea boundaries. The northwest trending fault systems, both within the valley and along the valley boundaries also act as vents for recent volcanism and surface lava flows.

The presence of lakes and marshlands in the lower Klamath Lake basin results from impermeable, clay-rich alluvium deposits which overlay most of the volcanic rocks in

this area (Ward, 1960). The impermeable alluvium maintains a separation of the surface waters from those in the underlying shallow volcanic aquifers.

Tule Lake: To the east of the Mt. Dome/Klamath Lake basin lies the Tule Lake basin. The Tule Lake Sump and National Wildlife Refuge are located within this basin, approximately 18 miles north-northeast of the project area. Surface water bodies, including Tule Lake, occupy approximately 15 to 20 square miles in the low flat valley. The Lava Beds National Monument is located immediately south of Tule Lake. Tule Lake and Lower Klamath Lake basins are separated by a north-trending faulted ridge of basalt lava flows, up to 800 feet in elevation above the valley floor.

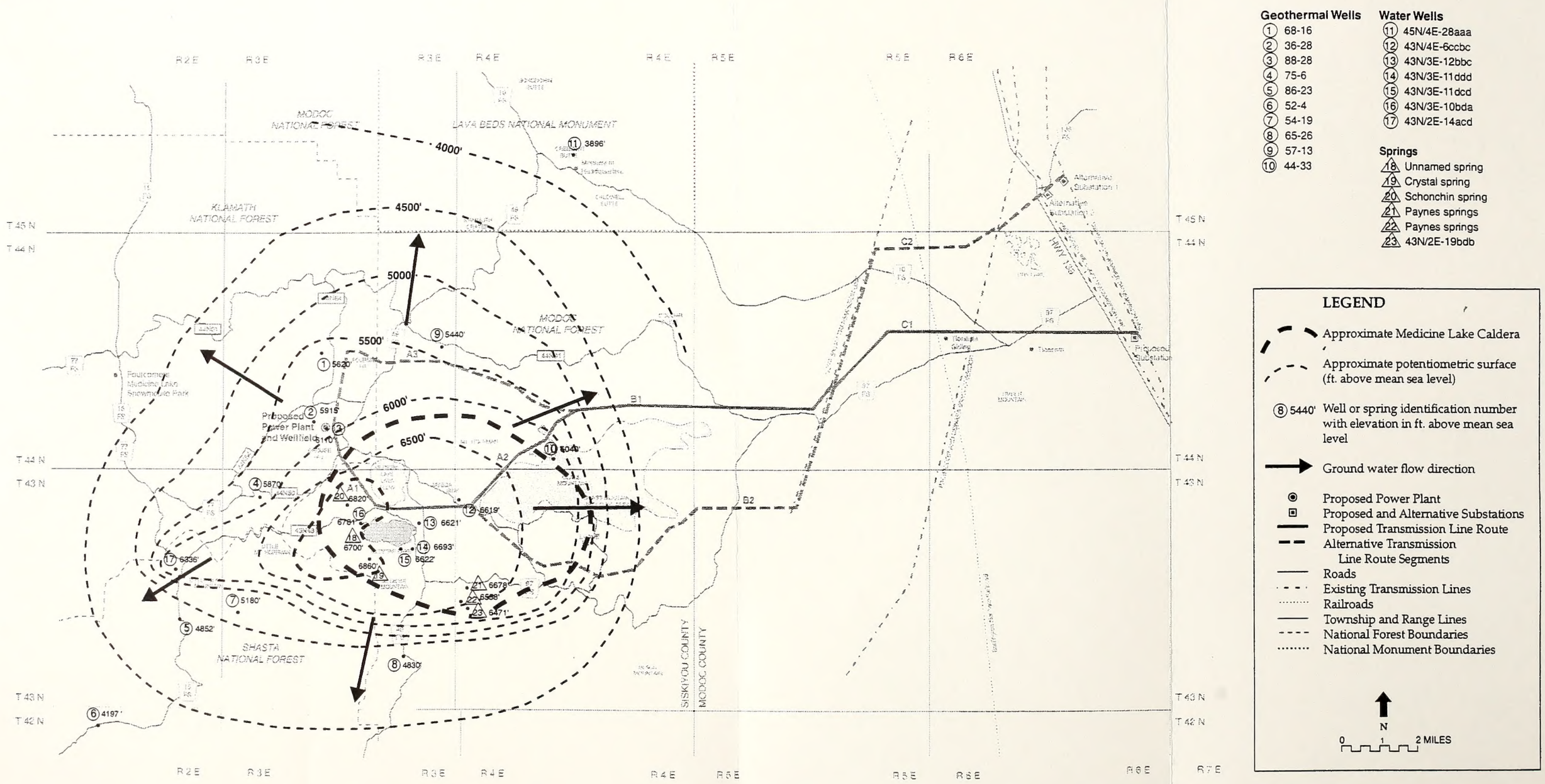
Shallow groundwater in the Tule Lake basin is recharged from the northern flanks of the Medicine Lake Highlands, east of the project area. Additional recharge comes from seepage loss from perennial streams and unlined canals. Groundwater flow is probably strongly controlled by the structural characteristics of the area, particularly faulting which has a strong northwest trend. It is unlikely that shallow groundwater would flow between the Mt. Dome and Tule Lake groundwater basins.

Butte Valley: To the west of the Mt. Dome basin lies Butte Valley. Butte Valley extends from approximately 25 miles northwest of Medicine Lake to the Oregon border and is a low, flat valley supporting extensive agricultural activities. It lies at the northern end of the Butte Valley Hydrologic Area and is primarily composed of low-permeability lakebed deposits with surrounding areas of much higher permeability basaltic volcanics. Precipitation in the volcanic plateau ranges from 20 to 30 inches, while at the valley floor precipitation averages only 10 to 15 inches (DWR 1973). Butte Valley supports few perennial streams so water supply comes almost solely from groundwater pumping.

The major aquifer for the Butte Valley groundwater supply is found in the Butte Valley basalt. About 75% of this basalt occurs as outcropping in the Cedar Mountain area, with 25% underlying the southern portion of the valley. The basalt flows are highly permeable because individual flows are thin with extensive fracturing and jointing resulting from rapid cooling (DWR 1973). Recent geologic mapping by the USGS has identified two primary basalt flow units that act as the primary aquifers (Christensen 1996, pers. com). The surface sources of these flows are vents located south of Tennant and on the northwest flank of Cedar Mountain. The recharge for the subsurface portion of these aquifers is therefore predominantly in the areas of surface exposure of the basalt flows, to the west and northwest of Fourmile Hill project area. The recharge area is estimated to be 75 square miles (DWR 1973). Given that there are no surface streams in the areas and the basalt flow surfaces are likely to be highly permeable, most of the precipitation would probably contribute to aquifer recharge.

The Butte Valley groundwater system does not appear to be significantly linked to the groundwater system associated with the Fourmile Hill area on the northwest flank of the volcano. The Butte Valley hydrologic basin is, at its nearest point, about 12 miles west of the project area and is separated topographically from the Fourmile Hill area by a drainage divide which includes several high mountains (Garner, Cedar, Sheep, and Mahogany Mountains, Figure 3.3-1).

Figure 3.3-3: Shallow Groundwater Levels and Estimated Flow Directions



Geothermal Wells

1. 68-16
2. 36-28
3. 88-28
4. 75-6
5. 86-23
6. 52-4
7. 54-19
8. 65-26
9. 57-13
10. 44-33

Water Wells

11. 45N/4E-28aaa
12. 43N/4E-6ccbc
13. 43N/3E-12bbc
14. 43N/3E-11ddd
15. 43N/3E-11dcd
16. 43N/3E-10bda
17. 43N/2E-14acd

Springs

18. Unnamed spring
19. Crystal spring
20. Schonchin spring
21. Paynes springs
22. Paynes springs
23. 43N/2E-19bdb

LEGEND

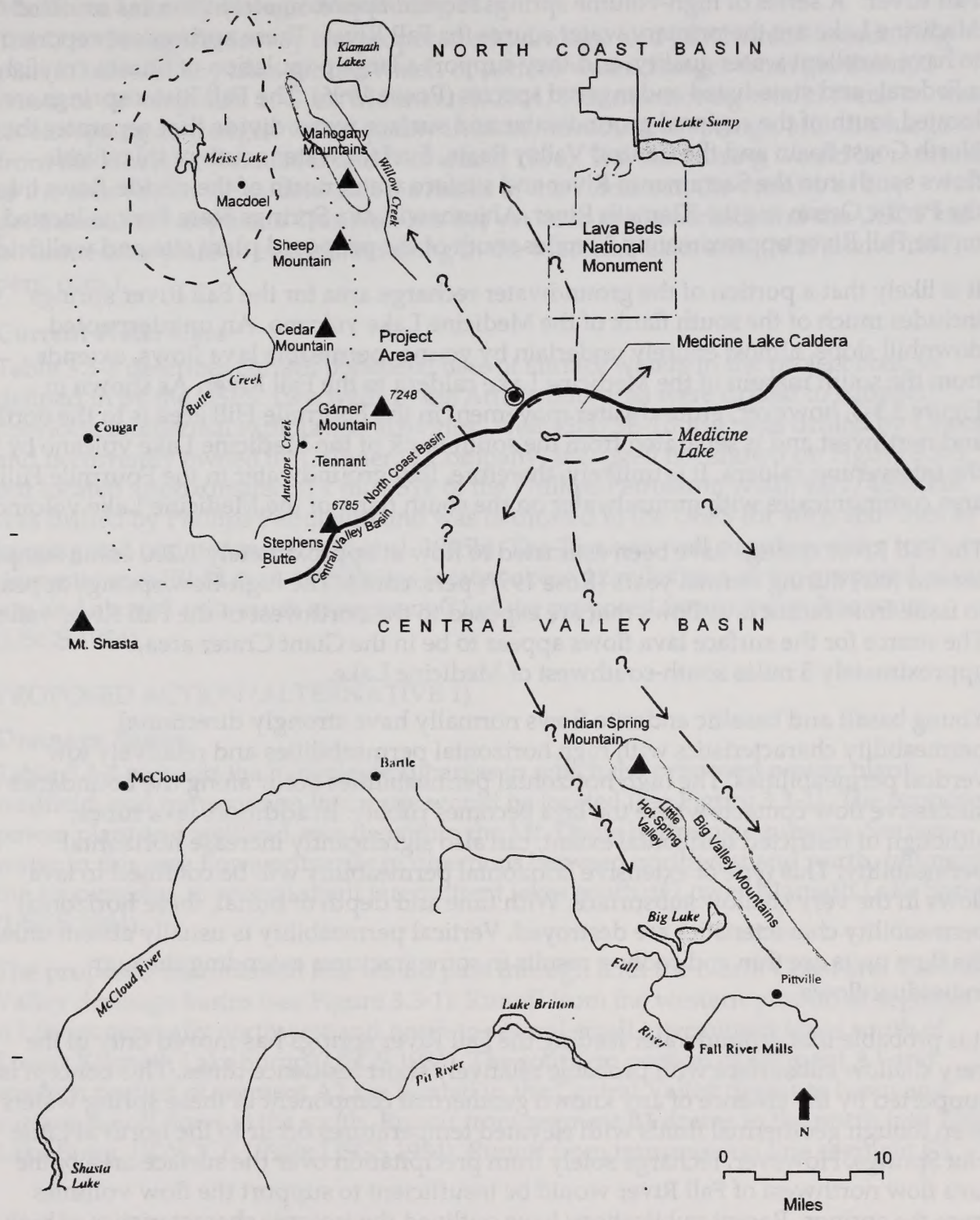
- Approximate Medicine Lake Caldera
- Approximate potentiometric surface (ft. above mean sea level)
- (8) 5440' Well or spring identification number with elevation in ft. above mean sea level
- Ground water flow direction
- Proposed Power Plant
- Proposed and Alternative Substations
- Proposed Transmission Line Route
- Alternative Transmission Line Route Segments
- Roads
- Existing Transmission Lines
- Railroads
- Township and Range Lines
- National Forest Boundaries
- National Monument Boundaries

N

0 1 2 MILES

SOURCE: EGS, Inc.

Figure 3.3-4: Estimated Regional Groundwater Flow Directions



LEGEND

- Butte Valley boundary (approximate)
- Butte Valley basin boundary (approximate)
- North Coast/Central Valley drainage basin divide

Base modified from U.S. Geological Survey
Hydrologic Unit Map—1978 State of California, 1978

MHA *Environmental Consulting, Inc.*

SOURCE: EGS, Inc.

Fall River: A series of high-volume springs located approximately 35 miles south of Medicine Lake are the primary water source for Fall River. These springs are reported to have excellent water quality, and they support a large population of Shasta crayfish, a Federal- and state-listed endangered species (Poore 1996). The Fall River springs are located south of the regional groundwater and surface water divide that separates the North Coast Basin and the Central Valley Basin. Surface water south of this divide flows south into the Sacramento River and surface water north of the divide flows into the Pacific Ocean via the Klamath River. Ahjumawi Lava Springs State Park is located on the Fall River approximately 30 miles south of the proposed plant site and wellfield.

It is likely that a portion of the groundwater recharge area for the Fall River springs includes much of the south flank of the Medicine Lake volcano. An uninterrupted downhill slope, almost entirely underlain by young, permeable lava flows, extends from the south margin of the Medicine Lake caldera to the Fall River. As shown in Figure 3.3-3, however, groundwater movement in the Fourmile Hill area is to the north and northwest and is separated from the south flank of the Medicine Lake volcano by the intervening caldera. It is unlikely, therefore, that groundwater in the Fourmile Hill area communicates with groundwater on the south flank of the Medicine Lake volcano.

The Fall River springs have been estimated to flow at approximately 1,200 cubic feet per second (cfs) during normal years (Rose 1997, pers. com.). The high-flow springs appear to issue from recent lava flows that are exposed to the northwest of the Fall River valley. The source for the surface lava flows appear to be in the Giant Crater area, approximately 5 miles south-southwest of Medicine Lake.

Young basalt and basaltic andesite flows normally have strongly directional permeability characteristics with high horizontal permeabilities and relatively low vertical permeabilities. The high horizontal permeabilities occur along the boundaries of successive flow contacts where the lava becomes rubbly. In addition, lava tubes, although of restricted horizontal extent, can also significantly increase horizontal permeability. This type of extensive horizontal permeability will be confined to lava flows in the very shallow subsurface. With time and depth of burial, these horizontal permeability characteristics are destroyed. Vertical permeability is usually absent unless the flow units are thin and cooling results in some fractures extending through individual flows.

It is probable that groundwater feeding the Fall River springs has moved only in the very shallow subsurface with probable relatively short residence times. This concept is supported by the absence of any known geothermal component in these spring waters even though geothermal fluids with elevated temperatures occur to the north at Little Hot Springs. However, recharge solely from precipitation over the surface area of the lava flow northwest of Fall River would be insufficient to support the flow volumes from the springs. Recent publications have outlined the isotopic characteristics of high volume springs in the Mt. Lassen area. These isotopic studies indicate that in shallow basaltic lava flows, groundwater has the potential to move large distances (Rose 1997, pers. com.).

Medicine Lake Hydrologic Monitoring Plan

The U.S. Geological Survey has proposed a hydrologic and geochemical monitoring plan to monitor any lake, groundwater, or surface water changes from geothermal resource development at Glass Mountain KGRA. This monitoring would focus on water levels, spring discharges, water quality in lakes, streams and springs, and discharge from the Hot Spot (Schneider and McFarland 1996). The monitoring would be restricted to the area within the caldera and the flanks of the volcano in the vicinity of any geothermal development. This plan has not yet been implemented, and the USGS has no immediate plans to begin monitoring in the Medicine Lake area (McFarland 1997, pers. com.).

Current Water Uses

Table 3.3-3 describes current beneficial uses of surface waters in the project area, as defined in by the USFS. Two wells in the Arnica Sink area were drilled to support previous geothermal exploration activities: well 43N/3E-1dddd[1] was drilled by Unocal and is currently owned by CalEnergy Company, Inc. (well not shown on Figure 3.3-3 but located approximately 0.1 mile SW of the Phillips Petroleum well); 43N/4E-6ccbc was drilled by Phillips Petroleum and was dedicated to the USFS for such activities as logging and maintenance (BLM et al. 1995b). The Tionesta well supplies water for non-domestic uses (BLM et al. 1995a); it is located about 12 miles east of the proposed plant site and about 1 mile south of segment C1 of the proposed transmission line route (USGS 1984).

PROPOSED ACTION (ALTERNATIVE 1)

Drainage Basins

Table 3.3-4 presents the hydrologic subareas in which the proposed power plant, wellfield, and transmission line route would be located (see Figure 3.3-1). The proposed power plant and wellfield area lie within the Mt. Dome hydrologic subarea. Surface water in this area flows primarily in directions between northwest and north, following the topography, to several small intermittent lakes south of Lower Klamath Lake Sump (USGS 1984).

The proposed transmission line would pass through both the North Coast and Central Valley drainage basins (see Figure 3.3-1). Runoff from the western portion of segment A1 flows generally northwest and north to several small intermittent lakes south of Lower Klamath Lake Sump (USGS 1984). The southern portion of segment A1 and western portion of segment A2 are located in the Central Valley drainage basin and surface runoff flows to the south. Runoff from segment B1 drains to the north into Tule Lake Sump (RWQCB 1994b; USGS 1984). Runoff from transmission line segment C1

[1] Well designations give the township and range location and section number. The letters indicate the location within the section — the first letter identifies the quarter section, the second the quarter-quarter sections, and the third the quarter-quarter-quarter section. Quarters are lettered counter-clockwise starting with "a" in the northeast quarter. Thus, well 43N/3E-14acd would be located in the southeast quarter of the southwest quarter of the northeast quarter of Section 14, Township 43 North, Range 3 East.

Table 3.3-3: Surface Water Uses

Waterbody	Domestic Use	Recreation	Fish Habitat
Medicine Lake	√	√	√
Crystal Springs Creek	√	√	√
Little Medicine Lake		√	√
Bullseye Lake		√	√
Paynes Creek		√	√
Blanche Lake		√	
Schonchin Spring	√		

SOURCE: USFS and BLM 1984

Table 3.3-4: Drainage Basins for the Proposed Action

Project Facility	Drainage Basin	Hydrologic Subarea
Power Plant and Wellfield	North Coast	Mt. Dome
Segment A1	Central Valley	Medicine Lake Crater
Segment A2	Central Valley	Medicine Lake Crater
Segment B1	North Coast	Tule Lake
Segment C1	North Coast	Tule Lake (small portion in Clear Lake)

SOURCE: RWQCB 1994a; RWQCB 1994b

flows into small intermittent lakes located a few miles north of Timber Mountain (USGS 1984).

Surface Waters

There are no perennial streams on the proposed power plant or wellfield areas. Three intermittent streams are shown on published maps of Calpine's geothermal leases:

- On Section 21, 29, and 30, T44N, R3E, with headwaters approximately one-half mile southwest of Fourmile Hill, flowing westward (USGS 1988a)
- On Sections 29 and 30, T44N, R3E, with headwaters about one-half mile west of Grouse Hill, flowing roughly west-northwestward (USGS 1988b)
- On Sections 22 and 23, T44N, R3E, with headwaters in Section 27 and in the small lake on Section 26, flows northeastward (USGS 1988c; USGS 1988e)

None of these streams are located in Riparian Reserves as defined by the Klamath and Modoc National Forests according to the Northwest Forest Plan.

There are no lakes, springs, or perennial or intermittent streams on Calpine's Fourmile Hill geothermal leases. The nearest lake to the power plant and wellfield area is about 1.5 miles southeast of Fourmile Hill (USGS 1988c). This unnamed lake is about one-eighth mile in diameter and an intermittent stream is shown draining the lake. This small lake is located in a breached crater at an elevation of approximately 7,200 feet and is several hundred feet above the power plant and wellfield site. It appears that this lake is fed by springs from a "perched" water table; that is, a water table that is located above the regional cold groundwater aquifer and separated from it by an unsaturated layer of rock. Groundwater elevations indicate that the lake probably discharges into the subsurface to the northwest, toward the power plant and wellfield area (Figure 3.3-3). The nearest spring to the power plant site is Schonchin Spring, located approximately 3 miles south of the power plant location. This spring flows to the southeast into Little Medicine Lake (USGS 1952).

There are no lakes, springs, or perennial or intermittent streams shown on the USGS topographic maps along the proposed transmission line route (USGS 1988a-e).

A portion of transmission line segment A1 would pass through a meadow that may meet the criteria to be defined as a wetland (see Section 3.7, Vegetation for a further description). The wet meadow is defined as a Riparian Reserve by the Modoc National Forest, according to the definition in the Northwest Forest Plan. No other portion of the proposed power plant and wellfield area and transmission line corridor would be located within an identified or possible wetland.

The Klamath National Forest classifies the Lower Klamath watershed, which includes the power plant and wellfield area, as a Class 1 watershed. This indicates the watershed is at or above "the inherent capability to produce biomass and function hydrologically as determined by physical, chemical, and biological factors and these lands are assumed to be able to produce high quality water year round" (USFS 1994b). However, average annual yield from the watershed is negligible (USFS 1994b).

No portion of proposed power plant and wellfield area and transmission line corridor would be located within a 100-year flood plain (BLM 1997, pers. com.).

Shallow Groundwater

Depths to the cold groundwater aquifer in the project area, vary from 200 feet within the caldera to between 300 feet and 1,000 feet on the flanks of the volcano (Schneider and McFarland 1996; Calpine 1985). At the power plant and wellfield site, the top of the shallow aquifer ranges from approximately 700 to 800 feet below the ground surface (Schneider and McFarland 1996; Calpine 1985). In the vicinity of the Arnica Sink water supply wells, the top of the shallow aquifer is found at a depth of approximately 98 feet (Schneider and McFarland 1996). Groundwater elevations for the Medicine Lake area are shown in Figure 3.3-3.

Table 3.3-5 presents data from water supply and abandoned temperature gradient wells within 7 miles of the proposed power plant and wellfield site. The table provides data on the depth to water in each well and the elevation of the water level above sea level. In addition, it lists the range of the groundwater production zone in terms of both depth and elevation. Table 3.3-6 presents water level data for springs in the area; however,

Table 3.3-5: Shallow Groundwater Data

Well	Depth to Water (ft)	Elevation of Water (ft msl)[1]	Groundwater Interval[4] Depth (ft)	Elevation (ft msl)	Date Measured
Water Supply Wells					
45N/4E-28aaa	658	3912	709-758	3861-3812	9/17/92
43N/2E-14acd	3	6336	0-4.7	6339-6334	9/16/92
43N/3E-10bda	12	6776	no data	no data	9/15/92
43N/3E-11ddd	7	6693	0-13.8	6700-6686	9/16/92
43N/3E-11dcd	137	6623	no data	?-6588	9/16/92
43N/3E-12bbc	179	6621	180-220	6620-6580	9/15/92
43N/4E-6ccbc	98	6619	?-535?	?-6182	9/16/92
Active Temperature Gradient Well					
88-28	800	6110	800-1060	6110-5850	9/94-10/94
Abandoned Temperature Gradient Wells					
68-16[2]	740	5620	740-2170	5620-4190	7/84-12/84
36-28[2]	765	5915	765-1440	5915-5240	7/84-12/84
75-6	810	5870	810-1560	5870-5120	7/84-12/84
86-23	1180	4852	1180-2700	4852-3332	7/84-12/84
52-4	1363	4197	1363-2840	4197-2720	7/84-12/84
54-19	1020	5180	1020-2025	5180-4175	7/84-12/84
65-26	1570	4830	1570-1750	4830-4670	7/84-12/84
57-13	710	5440	710-2020	5440-4130	7/84-12/84
44-33	900	6040	900-970	6040-5970	7/84-12/84
45-36	800[3]	6155	800-1665	6155-5290	10/83
28-32	953[3]	6272	953-1453	6272-5790	7/84
56-3	725[3]	5995	725-1845	5995-4875	9/82
17-6	789[3]	6081	789-1845	6081-4660	11/82
84-17	613[3]	6337	613-1000	6337-5950	10/82
87-13	347[3]	6508	347-675	6508-6180	9/82
62-21	920-1160	5440-5680	920-1220	5680-5380	7/84-12/84
52-30	813[3]	5507	no data	no data	7/83
18-34	1010-1340	4460-4790	1010-2800	4790-3000	7/84-12/84
27-27	1300-1840	3975-4515	1300-2470	4515-3975	7/84-12/84

Notes:

[1] Groundwater elevation data were obtained from selected temperature gradient wells prior to well abandonment. The lower section of the geothermal wells were sealed using cement and then the upper portion perforated in the upper shallow groundwater zone. (Beall 1996, pers. com.). Groundwater elevations were calculated from fluid pressure surveys run in each well. In most cases the pressure survey profiles were sufficiently consistent to allow projection of zero pressure conditions (i.e. top of groundwater in well). In some wells, estimation of zero pressure was less reliable due to non-linear pressure survey profiles. These less certain groundwater elevations are shown as ranges.

[2] Located within Calpine's Fourmile Hill leases.

[3] Estimated from driller's reports. Below this level, water was always encountered when lowering drilling equipment into wellbore (Beall 1997).

[4] Lower limit of shallow water table assumed to coincide with a measured temperature of 90° F.

SOURCES: Schneider and McFarland 1996; Calpine 1985; Beall 1997

Table 3.3-6: Spring Data

Spring	Depth to Water (ft)	Water Elevation (ft msl)	Date
43N/3E-3cdc	(dry)	6820	9/15/92
43N/3E-10acb	0	6700	9/15/92
43N/3E-15abd	0	6860	9/15/92
43N/4E-19bca	0	6558	9/16/92
43N/4E-19bdb	0	6471	9/16/92
43N/4E-18cdcc	0	6678	9/16/92

SOURCE: Schneider and McFarland 1996

spring elevations do not necessarily represent shallow groundwater elevations. In many cases springs are discharge points for local shallow, perched aquifers.

Groundwater flow directions interpreted from the groundwater elevation map (Figure 3.3-3) vary from west-northwest to north-northeast at the power plant and wellfield area.

Table 3.3-7 presents water chemistry data from groundwater wells and groundwater-fed springs in the Medicine Lake Highlands. These wells and springs were chosen because of their proximity to the project site and because their was sufficient data collected at these sites. Table 3.3-7 also presents geothermal fluid chemistry data from the Telephone Flat well 87-13. A portion of these data are found in Table 3.4-1.

Table 3.3-7 shows that the chemical composition of the groundwater in the Medicine Lake Highlands, regardless of their source (i.e., wells or springs), is substantially different from the chemical composition of the geothermal fluid. Many constituents in the geothermal fluids, such as total dissolved solids, silica, sodium, and chloride, are two to three orders of magnitude more abundant than in the shallow groundwater. Other constituents in the geothermal fluids, such as potassium, boron, and iron, are several times more abundant than in the shallow groundwater.

ALTERNATIVES

As discussed at the beginning of this chapter, the affected hydrologic environment for each alternative to the proposed action is described after that of the proposed action. For Alternatives 2 through 6, the affected environment for the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route. Descriptions of the existing environment along these portions of the transmission line are not repeated under each alternative discussion. The environment for Alternative 7, the No Action alternative, would be the same as that described for Alternatives 1 through 6.

The description of the affected environment for the alternatives focuses on the environment along the segments of the transmission line that would be different from those in the proposed action.

Alternative 2 (A1, A2, B1, and C2)

Under Alternative 2, transmission line segment C2 would replace segment C1. The affected environment for the power plant and wellfield area, and transmission line segments A1, A2, and B1 would be the same under this alternative as described above for the proposed action.

Segment C2: Segment C2 would be located within the North Coast Basin with the majority of the segment in the Tule Lake subarea and a small portion passing through the Clear Lake subarea. Runoff from segment C2 would flow into small intermittent lakes located a few miles north of Timber Mountain (USGS 1984). There are no lakes, springs, or perennial streams located along segment C2. Segment C2 would cross an intermittent stream just west of its terminus at the alternative substation (USGS 1988d). Segment C2 would also pass a seasonal wetland in the vicinity of Dry Lake. Neither the stream nor wetland are located within Riparian Reserves areas since they are located outside of the area regulated by the Northwest Forest Plan (see Section 3.10, Plans and Policies).

Alternative 3 (A1, B2, and C1)

Under Alternative 3, transmission line segment B2 would replace segments A2 and B1. The affected environment for the power plant and wellfield area, and transmission line segments A1 and C1 would be the same under this alternative as described above for the proposed action.

Segment B2: Segment B2 would pass Medicine Lake Crater and Long Bell subareas in the Central Valley drainage basin and the Tule Lake subarea in the North Coast. There are no lakes, springs, or perennial streams located along segment B2.

Alternative 4 (A1, B2, and C2)

Under Alternative 4, transmission line segment B2 would replace segments A2 and B1, and segment C2 would replace segment C1. The affected environment for the power plant and wellfield area and transmission line segment A1 would be the same under this alternative as described above for the proposed action. Existing conditions along segments B2 and C2 are described above under Alternatives 3 and 2, respectively.

Alternative 5 (A3, B1, and C1)

Under Alternative 5, transmission line segment A3 would replace segments A1 and A2. The affected environment for the power plant and wellfield area and transmission line segments B1 and C1 would be the same under this alternative as described above for the proposed action. The existing conditions along segment A3 are described below.

Segment A3: The western portion of segment A3 would be located within the Mt. Dome hydrologic subarea and the eastern portion in the Tule Lake subarea. Runoff from the western portion of segment A3 would flow generally northwest and north to several small intermittent lakes south of Lower Klamath Lake Sump (USGS 1984).

Table 3.3-7: Chemical Analyses for Groundwater Wells, Groundwater Springs, and Geothermal Well near the Project Area

	Groundwater Wells		Groundwater from Springs[a]			Geothermal Fluid	
Constituent (ppm)	Pumice Stone[b,c]	Crescent Butte[d]	Schon-chin Spr.[c]	Crystal Spring[c]	Payne Spr. (N)[c]	87-13 11/6/89[e]	87-13[e] 10/13/91
pH	6.3	7.8	6.7	6.6	6.4	8.6	8.5
Total Dissolved Solids	36	150	88	57	59	NR	2,337
Silica	16	49	32	28	29	582.3	442.0
Sodium	1.3	26	3.1	2.3	2.6	632.0	442.0
Chloride	< 1.8	11.0	< 1.8	< 1.8	< 1.8	1,012.2	1,085.0
Bicarbonate	13.9	89.0	41.6	20.8	20.8	49.0	28.0
Potassium	1.2	1.8	1.0	0.8	1.3	107.7	77.0
Sulfate	< 5.0	3.0	< 5.0	< 5.0	< 5.0	46.9	46.0
Boron	< 0.01	0.3	< 0.01	0.03	< 0.01	NR	10
Calcium	3.1	3.0	8.6	3.9	3.8	7.9	4.3
Iron	< 0.05	0	< 0.05	< 0.05	< 0.05	NR	0.36
Magnesium	0.6	0.9	2.0	1.1	1.1	0.1	ND
Manganese	< 0.01	NR	< 0.01	< 0.01	< 0.01	NR	ND
Nitrate	< 0.4	0.6	< 0.4	< 0.4	< 0.4	NR	ND

Notes:

[a] Locations of springs shown in Figure 3.3-2 in the EIS/EIR

[b] Pumice Stone Well located approximately 1 mile west of Little Glass Mountain

[c] Data from Cosens-Gallinatti (1984) cited in Weiss Associates (1997)

[d] National Park Service well in Lava Beds National Monument; data from Leivas et al. (1981) cited in Weiss Associates (1997)

[e] Data collected on two different dates from well 87-13 at Telephone Flat; Source: USFS et al. (1998) (also cited in part in Table 3.4-1 of the Draft EIS/EIR); data are flash-corrected

ND = Not detected and detection limit not given

NR = Not reported

Runoff from the eastern portion of segment A3 would drain into Tule Lake Sump (RWQCB 1994b; USGS 1984). There are no lakes, springs, or perennial streams located along segment A3. USGS maps indicate that segment A3 would cross two intermittent streams (USGS 1988e):

- Northeast of Fourmile Hill in T44N, R3E (Section 23); stream is parallel to Forest Road 49
- Southwest of Aspen Crater in T44N, R4E (Section 19)

Neither of these streams are within Riparian Reserves as defined by the Northwest Forest Plan.

Alternative 6 (A3, B1, and C2)

Under Alternative 6, transmission line segment A3 would replace segments A1 and A2, and segment C2 would replace segment C1. The affected environment for the power plant and wellfield area and transmission line segment B1 would be the same under this alternative as described above for the proposed action. Existing conditions along segments A3 and C2 are described above under Alternatives 5 and 2, respectively.

Alternative 7 (No Action)

The setting for Alternative 7, the No Action alternative would be the same as for the proposed project.

3.4 Geothermal Resources

DEFINITION OF STUDY AREA

The geothermal resource study area for this EIS/EIR focuses primarily on the Medicine Lake Highlands area and the Glass Mountain KGRA. The power plant and wellfield area would be located on the northwest flank of the Medicine Lake volcano. In addition to the geothermal resources in the immediate vicinity of the power plant and wellfield, the geothermal analysis also considered regional geothermal resources, including those located in Butte Valley and Fall River.

METHODOLOGY

Material reviewed as part of this analysis included proprietary well testing data provided by Calpine Corporation, as well as reference material on Medicine Lake volcano and USGS topographic maps. Environmental review documents prepared for earlier geothermal proposals within the Glass Mountain KGRA were also consulted. A site reconnaissance of the power plant and wellfield area was conducted and knowledgeable persons were consulted about geothermal systems and the resources of the region.

REGIONAL OVERVIEW

Introduction

Medicine Lake volcano is a broad shield volcano composed of basaltic and rhyolitic lavas. An active geothermal system associated with recent volcanic activity has been demonstrated in the vicinity through exploration studies, drilling, and well testing. The heat source for the geothermal resource is believed to be a shallow basaltic magma chamber (Donnelley-Nolan 1990). Surface manifestations of this system are limited to a pair of fumaroles known as the Hot Spot (Figure 3.3-2), located on the northwest flank of Glass Mountain approximately 3 miles east-southeast of the proposed plant site.

The central section of the Medicine Lake volcano is a caldera structure, elliptical in shape and lower in topographic relief than the surrounding caldera rim. The caldera structure is a collapse feature resulting from a major eruptive phase of volcanism and followed by collapse of the vent area due to magma withdrawal. The project area is located outside of the caldera on the northwest rim. The margins of the caldera are marked by inward dipping ring fractures that form the boundary between the flank lavas and pyroclastic rocks and the different lithologic rocks forming the interior of the caldera (Donnelley-Nolan 1996, pers. com.). The geologic and volcanic setting of the volcano is described in Section 3.2, Geology and Soils.

Glass Mountain KGRA

The electricity potential for the Glass Mountain KGRA has been estimated at 500 MW for a 30 year period (USFS and BLM 1984); this figure was based on the estimated total thermal energy calculated from limited reservoir data. Experience has shown that the actual number of MW that can be economically produced or developed from the resource may be much less than the calculated electrical potential.

Exploration of the geothermal resources of the Glass Mountain KGRA began in the early 1980s with geologic mapping, geophysical surveys, and drilling of a number of temperature gradient and deep exploration wells. These geothermal exploratory programs were conducted by a number of development companies, all of whom had leases within the KGRA.

A total of 24 temperature gradient wells were drilled within the KGRA by Unocal, Occidental Petroleum, and Phillips Petroleum between 1981 and 1984. These wells were drilled to depths of approximately 2,000 feet or greater. A deep test well (17A-6) was drilled by Occidental and Phillips in 1984, and three deep test wells, 68-8, 31-7 and 87-13 were drilled by Unocal in 1985, 1988 and 1989, respectively. Well 87-13 was deepened in 1991.

In 1994, Calpine Corporation, the project proponent, drilled a temperature gradient corehole (88-28) at the project site. The well was completed at a depth of 3,604 feet and indicated that commercial geothermal resource temperatures existed within Calpine's leased project area. Location of deep test wells and those temperature gradient wells for which there are groundwater elevation data are presented in Figure 3.3-3. Wells completed inside the caldera include: 45-36, 28-32, 17A-6, 31-17, and 68-8. Wells completed outside of the caldera include: 68-16, 86-23, 54-19, 62-21, 65-26, 18-34, 27-27, and 54-29. The location of 87-13, and 84-17 appear to be within the caldera rim fracture system.

Only the four deep test wells, 17A-6, 68-8, 31-17 and 87-13 were designed to allow for production of reservoir fluids. All data from these wells are proprietary and therefore not available for inclusion in this document. However, a generally accepted interpretation of the geothermal system is that fluids are heated at depth by a magmatic heat source of limited size underlying the caldera. Heated fluids migrate upwards within either the caldera ring fracture system or other fractures within the caldera and then migrate laterally outwards into more permeable units within the intra-caldera and flank volcanic sequences.

Glass Mountain Thermal Features

Based on an examination of topographic maps and consultation with knowledgeable persons, the nearest surface thermal feature to the proposed power plant site and wellfield appears to be the Hot Spot, located on the northwest flank of Glass Mountain about five miles east of the power plant and wellfield area (USFS 1982; USFS and SCS 1983). This feature consists of two small-diameter fumaroles which emit a small amount of water vapor and gas, consisting mostly of air (nitrogen and oxygen). The gases are lacking in hydrogen sulfide, an ubiquitous indicator of geothermal fluids. Therefore, it appears that the emanations at the Hot Spot represent heated groundwater and not a surface leakage of geothermal fluids. The lack of any other surface manifestations, either within or outside of the caldera, suggests that this is a very isolated and locally constrained feature. No other surface thermal features at or adjacent to the project area were found in the references consulted.

Other Thermal Features

Klamath Falls Area: A low temperature geothermal resource exists in the Klamath Falls area, over 30 miles north of the project area. This resource has been developed for commercial use within the city. The geothermal system at Klamath Falls is primarily fault-controlled; the fluids have been heated by deep circulation within these faults.

Butte Valley Area: Two wells in the Butte Valley area are reported to have water temperatures of 82°F - 86°F (CDMG 1983). One well (48N1W-28F1-M) is located approximately 3.5 miles west of Dorris, and the other, unnamed well is approximately four miles southeast of Dorris. Both appear to be located along major, northwest, normal faults and close to Quaternary/Pliocene volcanic centers. Other warm wells probably exist in the area.

The association of volcanics and normal faults suggest strongly that the elevated temperatures are due to localized deep circulation and heating within the fault zones. Given the geologic setting, it is probable that the warm wells in the Butte Valley are related to those in Klamath Falls, or a similar type of low temperature system resulting from deep circulation. It is highly unlikely that the elevated temperatures could result from heating in the Medicine Lake area, approximately 25 miles to the southeast.

Fall River Area: A number of warm springs and wells exist to the south of Medicine Lake. Little Hot Springs, Basset Hot Springs, and Kellog Hot Spring are all located approximately 20 to 30 miles southeast of the project site and produce water at discharge rates of 4 to 80 gallons/minute. All three warm springs are in different hydrologic units from the project site.

Little Hot Springs issues from along a linear fault zone bounding the valley and 10 miles to the northwest of Fall River springs. Spring chemistries are available with geothermometers that indicate subsurface temperatures in the range 140 to 265°F. Because highly permeable basalts underlie most of the area, the hot springs have been interpreted to be rising along structural barriers to the groundwater flow (CDOG 1975).

PROPOSED ACTION (ALTERNATIVE 1)

Geothermal Resource

Geothermal systems require a heat source, a fluid as a transportation mechanism, and a natural reservoir within the rocks. In most geothermal systems, the heat source is a discrete body of magma of limited areal extent (usually a mile or two in diameter) at a distance of a few miles below the earth's surface. Fluid becomes heated at depth where it normally remains in the liquid state at temperatures above that of the boiling point of water at the earth's surface. The fluid may remain in circulation beneath the earth's surface or will sometimes leak to the surface in the form of geysers, fumaroles, and hot springs. What allows the movement of the fluids, and hence the transfer of the magmatic heat, is the reservoir within the rocks. Unlike oil and gas reservoirs or groundwater aquifers, which are almost always controlled by horizontal porous rock layers, geothermal reservoirs are usually controlled by discrete vertical or high-angle faults and fractures. This type of fracture permeability, along with the small areal extent of the magmatic heat source, means that geothermal systems are generally limited in areal extent.

In order to develop geothermal resources it is necessary to first test areas for subsurface temperature distribution. This is usually accomplished by drilling temperature gradient or core holes. These wells do not produce fluids, and are not generally tested for fluid production capability. If the temperature results are encouraging, larger diameter holes are then drilled and the resource is tested at the surface to determine its production capabilities and characteristics.

Calpine drilled temperature gradient well 88-28 in 1994 on the proposed power plant site at Fourmile Hill (see Figure 3.3-3). Three other temperature gradient wells (36-28, 68-16, and 14-23) have been drilled previously on Calpine's Fourmile Hill geothermal leases by other companies. Hydrologic data from well 36-28 and 68-16 are presented in Table 3.3-5. No hydrology data are available from well 14-23. The zone of high temperature gradient is shallowest near the ring of fracture zone which is closest to well 88-28. To the north and northwest, the depth to the high temperature gradient zone increases and the magnitude of the temperature gradient diminishes gradually (i.e., temperatures increase less rapidly with depth).

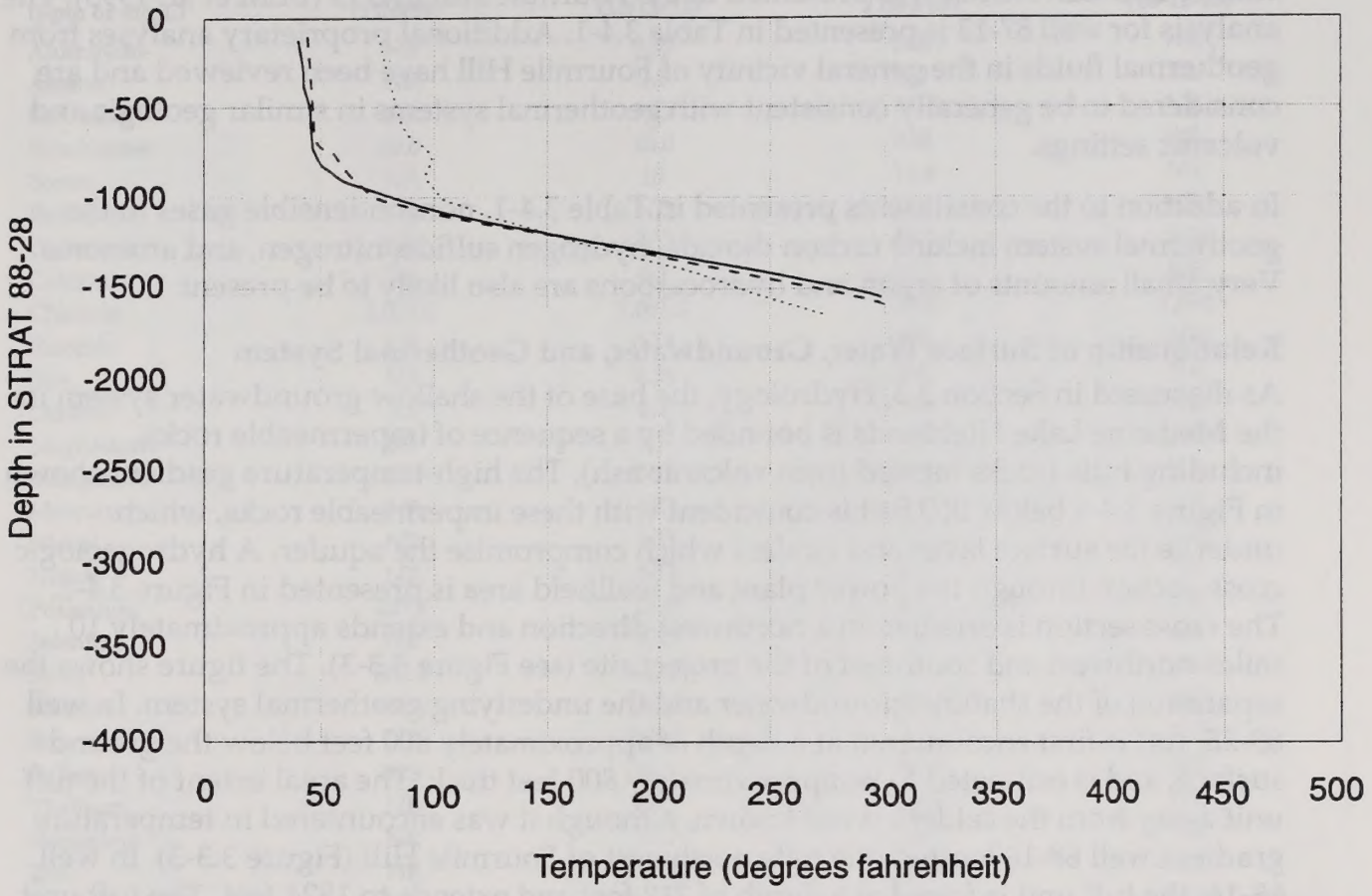
Well 88-28 was drilled to a total depth of 3,604 feet as a corehole. The corehole was designed to study rock formations and temperatures at depth. The well was not designed to encounter or produce reservoir fluids; therefore, no reservoir fluid data are available from this well. The maximum temperature recorded in the well was sufficiently high to suggest the presence of a geothermal system capable of commercial development, if adequate geothermal fluids are available. The system would likely occur at a minimum depth of 3,500 feet below the surface.

The geothermal system in the Fourmile Hill area has been interpreted by the project developer to be primarily controlled by upward movement of geothermal fluid within the caldera ring fracture system. As the confining pressure decreases the fluids are thought to move outward into adjacent fracture systems. Fluids are confined to vertical or subvertical fractures as horizontal permeability at these depths would be minimal.

A review of data provided by Calpine indicates that impermeable zones of tuff (rocks formed from volcanic ash) overlie fractured lavas at depth in well 88-28 and act as a barrier to upward migration of the geothermal fluids (see also Figure 3.3-3). Two specific factors support this interpretation:

- The sequence of lithic tuffs was encountered in the corehole from approximately 800 feet to 1,600 feet depth. Samples of this unit indicated extensive clay alteration and generally highly impermeable formation conditions.
- A high temperature gradient zone was identified in well 88-28 (see Figure 3.4-1) coinciding with the zones of lithic tuff. The high smooth temperature gradient curve is indicative of low permeability rocks with little or no inflow of fluid from the formation (Figure 3.4-1). Below this unit the temperature gradient curve became far more irregular with strong spiked zones and localized temperature reversals, indicative of fluid flow near the wellbore. This lower portion of the temperature gradient curve was not available for Figure 3.4-1 because the data are proprietary.

Figure 3.4-1: Temperature Versus Depth Profile for Well 88-28



LEGEND

Downhole Temperature Survey

- 11/07/94
- 11/11/94
- 11/13/94

SOURCE: Calpine

Chemistry of Fourmile Hill Geothermal Fluids

No geothermal fluid samples have been obtained from the geothermal system in the Fourmile Hill area, and thus no fluid analyses from the resource believed to underlie Calpine's leases are available. A general chemical analysis of geothermal fluids from the Glass Mountain KGRA was presented in the Fourmile Hill EA/IS (BLM et al. 1995). The analysis for well 87-13 is presented in Table 3.4-1. Additional proprietary analyses from geothermal fluids in the general vicinity of Fourmile Hill have been reviewed and are considered to be generally consistent with geothermal systems in similar geologic and volcanic settings.

In addition to the constituents presented in Table 3.4-1, noncondensible gases in the geothermal system include carbon dioxide, hydrogen sulfide, nitrogen, and ammonia. Very small amounts of argon and hydrocarbons are also likely to be present.

Relationship of Surface Water, Groundwater, and Geothermal System

As discussed in Section 3.3, Hydrology, the base of the shallow groundwater system in the Medicine Lake Highlands is bounded by a sequence of impermeable rocks, including tuffs (rocks formed from volcanic ash). The high-temperature gradient shown in Figure 3.4-1 below 800 feet is coincident with these impermeable rocks, which underlie the surface lavas and cinders which compromise the aquifer. A hydrogeologic cross-section through the power plant and wellfield area is presented in Figure 3.4-2. The cross section is oriented in a northwest direction and extends approximately 10 miles northwest and southeast of the project site (see Figure 3.3-3). The figure shows the separation of the shallow groundwater and the underlying geothermal system. In well 88-28, tuff is first encountered at a depth of approximately 800 feet below the ground surface, and is estimated to be approximately 800 feet thick. The areal extent of the tuff unit away from the caldera is not known, although it was encountered in temperature gradient well 68-16 located one mile northwest of Fourmile Hill (Figure 3.3-3). In well 68-16, the tuff unit is found at a depth of 712 feet and extends to 1824 feet. The tuff unit dips away from the caldera and thins towards the northwest.

Data from numerous temperature gradient wells in the Medicine Lake Highlands support the interpretation that there is an impermeable barrier between the shallow, cold groundwater and the geothermal reservoir. The temperature gradient data indicate two important thermal characteristics which document the impermeability of the rocks which underlie the aquifer:

- A cold, nearly isothermal (constant temperature) section extending from the ground surface to the base of the shallow groundwater
- A rapidly increasing temperature in the impermeable layer beneath the shallow groundwater

Figure 3.4-3 shows a hydrologic/isothermal cross-section through the caldera rim fractures and illustrates the relationship between temperature and the different geologic layers. The temperature gradients measured in two temperature gradient holes are shown above the cross section in order to illustrate graphically the relationship between the temperature gradient and cold water table (Beall 1997). Data from the four temperature gradient wells in Table 3.3-5 support the model illustrated in Figure 3.4-3. In addition to the temperature gradient data, the absence of geothermal surface

Table 3.4-1: Chemical Analyses of Geothermal Fluids from Wells 87-13, 68-8, and 31-17 – Medicine Lake Caldera

	Geothermal Fluids from Well		Fluids from Sumps from Wells[2]	
Constituent (ppm or mg/L)	**87-13 (11/6/89)[1]**	**87-13 (10/13/91)[1]**	**68-8 (10/6/89)**	**31-17 (10-12-88)[3]**
Aluminum	NR	0.59	NR	NR
Arsenic	NR	0.6	6.0	5.1
Beryllium	NR	ND	ND	NR
Bicarbonate	49.0	28.0	NR	NR
Boron	NR	10	14.9	NR
Bromide	NR	ND	NR	NR
Cadmium	NR	ND	ND	NR
Calcium	7.9	4.3	27.1	NR
Chloride	1,021.2	1,085.0	1,930	1,860
Fluoride	NR	0.74	5.9	NR
Iron	NR	0.36	NR	NR
Lithium	3.1	2.2	NR	NR
Magnesium	0.1	ND	NR	NR
Manganese	NR	ND	NR	NR
Mercury	NR	ND	ND	NR
Nickel	NR	ND	ND	NR
Nitrate	NR	ND	NR	NR
Potassium	107.7	77.0	186.0	NR
Selenium	NR	ND	NR	NR
Silica	582.3	442.0	721.0	NR
Sodium	632.0	442.0	1,050.0	NR
Strontium	NR	0.025	NR	NR
Sulfate	46.9	46.0	42.4	NR
Thallium	NR	ND	0.002	NR
Vanadium	NR	ND	NR	NR
Zinc	NR	0.028	0.021	NR
Total dissolved solids	NR	2,337	4,030	3,870
pH	8.6	8.5	6.9[4]	8.0

Notes:

[1] Data are flash-corrected

[2] Data are from samples collected in the well sumps; it is unknown (1) how long sump fluids had been present in the sumps prior to sampling, (2) whether sump fluids mixed with precipitation or snow, or (3) whether sump fluids experienced any evaporation.

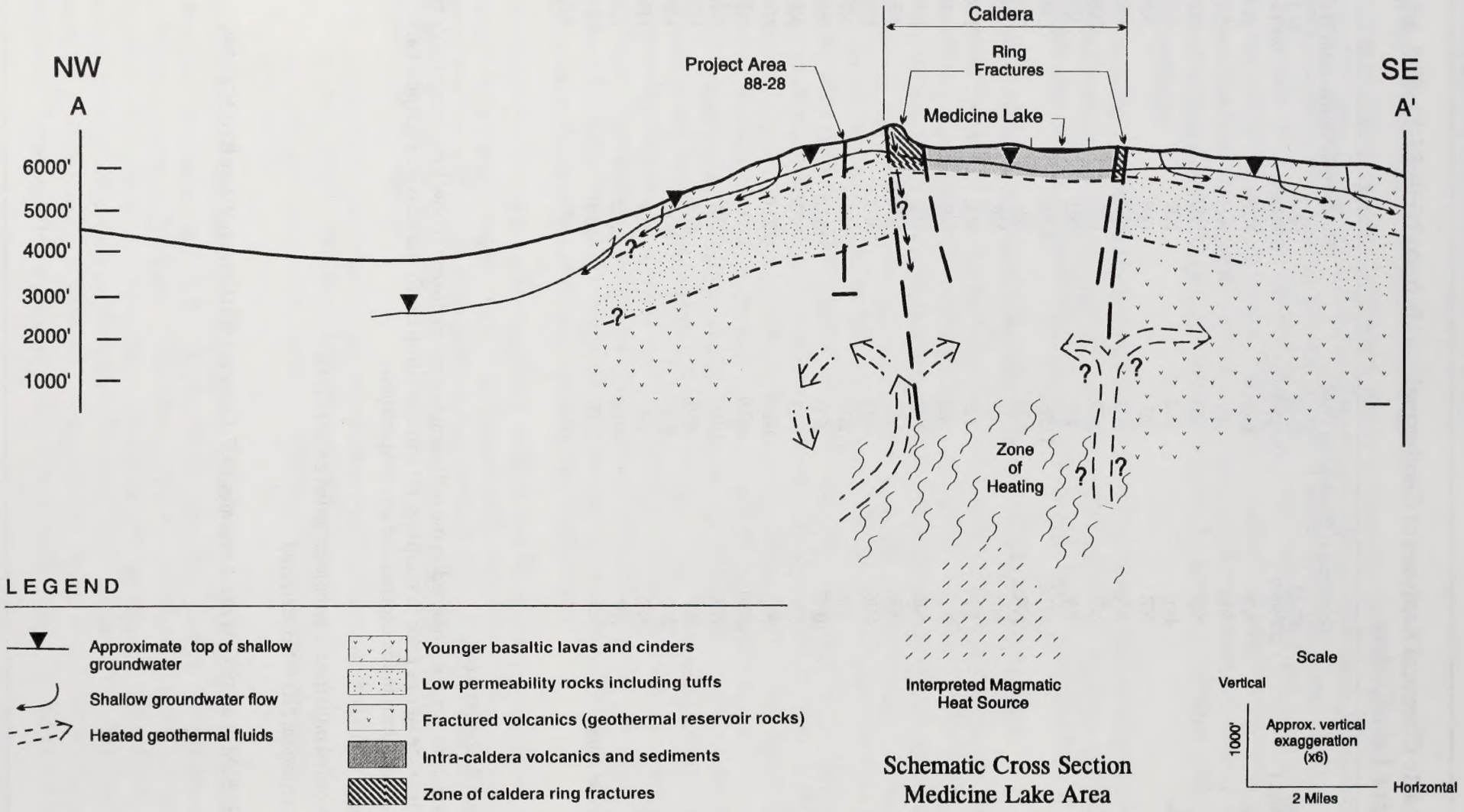
[3] Formerly well 21-17

[4] pH recorded only from a sample collected on 10/12/88

NR = Not reported; ND = Not detected

SOURCES: BLM et al. 1995; Weiss Associates 1997; Calpine 1998; Central Valley RWQCB 1998

Figure 3.4-2: Schematic Cross Section of Medicine Lake Area



Refer to Figure 3.3-3 for A to A' Cross Section

MHA *Environmental Consulting, Inc.*

SOURCE: EGS, Inc.

Figure 3.4-3: Hydrologic/Isothermal Cross Section Through Caldera Rim Fractures

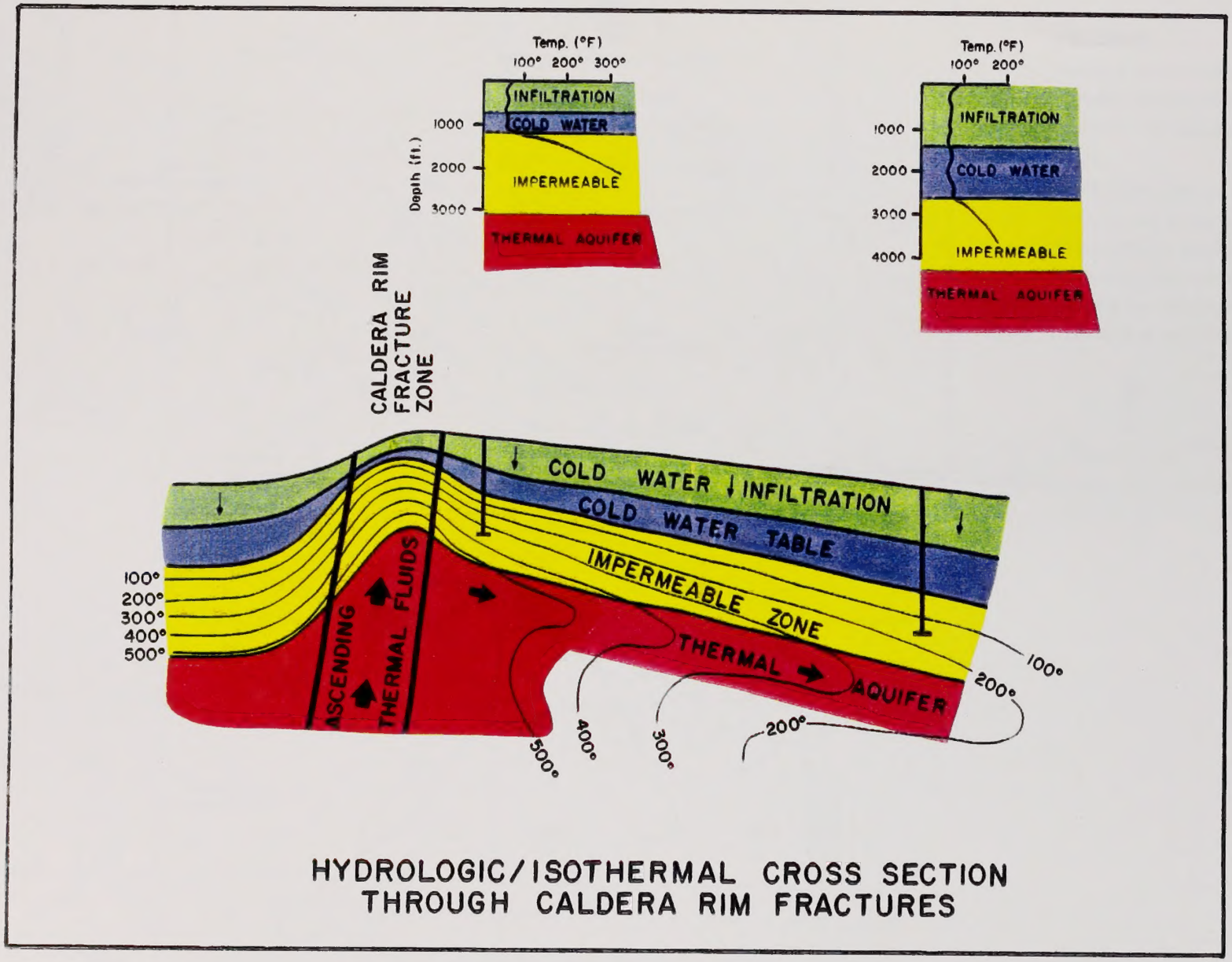
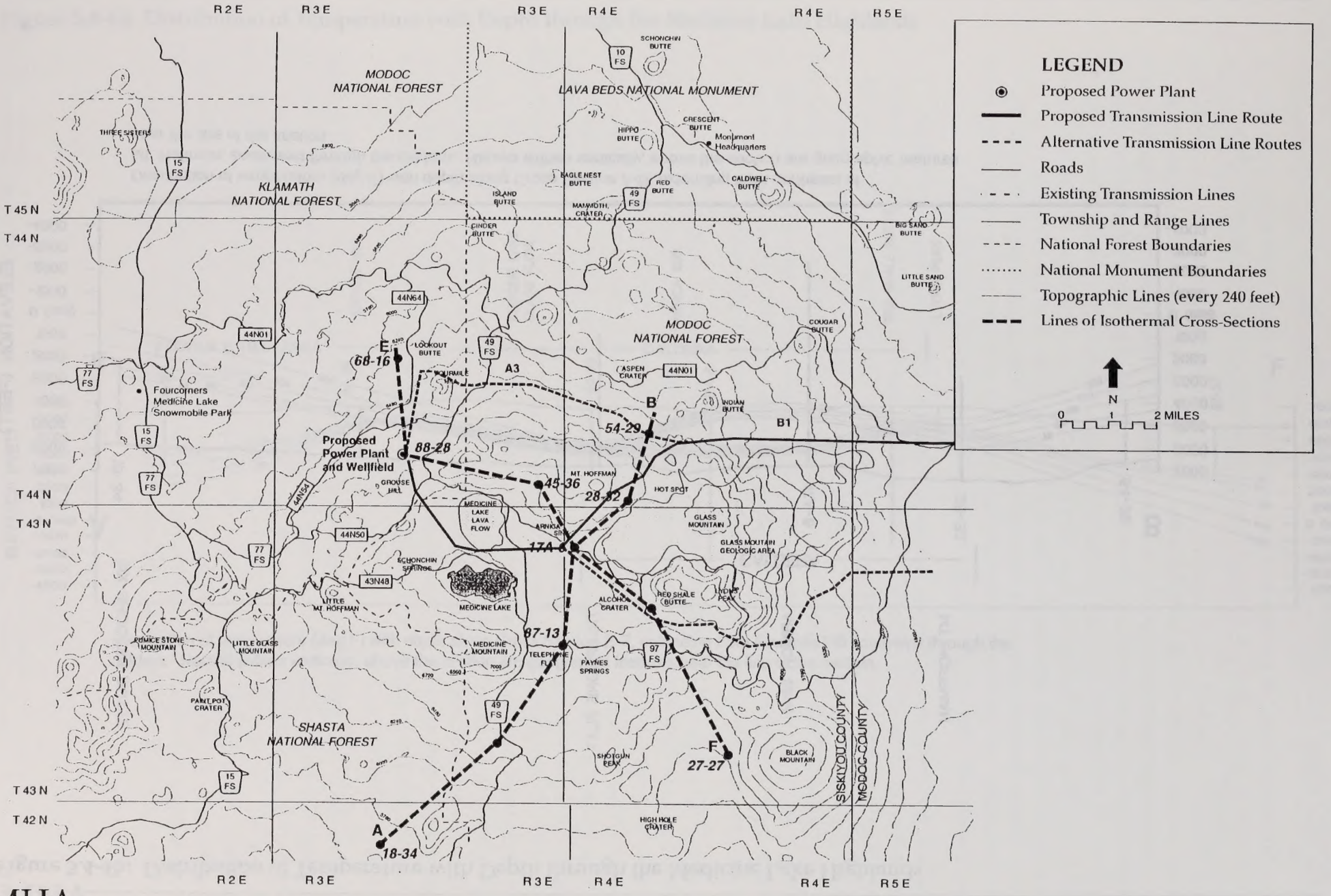
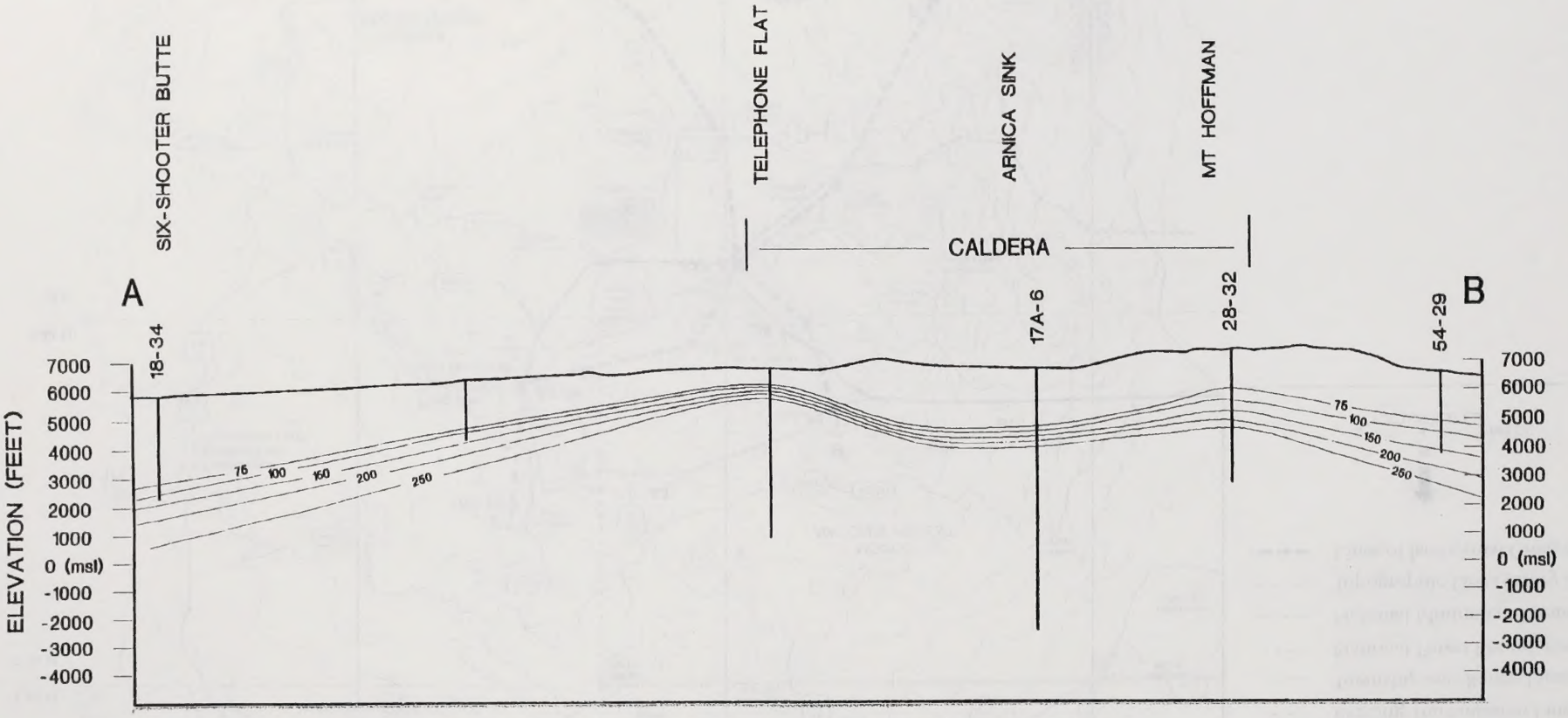


Figure 3.4-4a: Locations of Isothermal Cross Sections



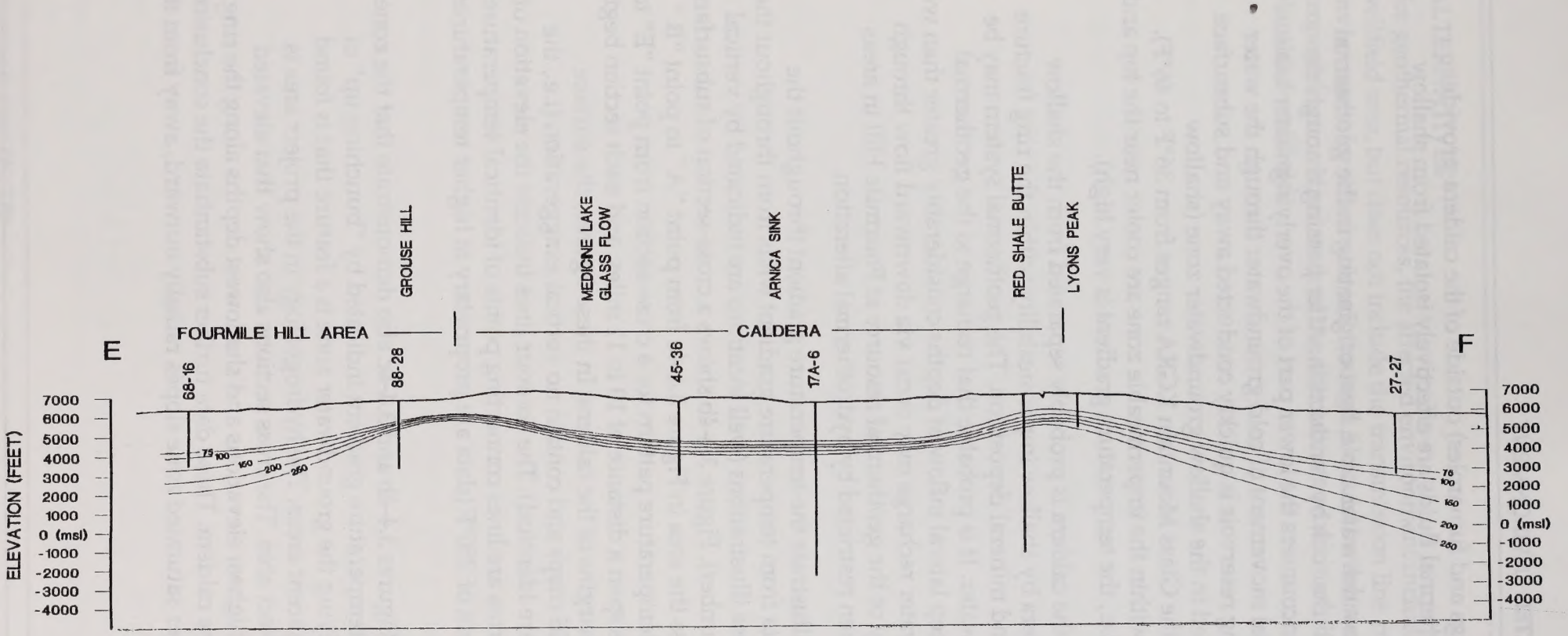
MHA *Environmental Consulting, Inc.*

Figure 3.4-4b: Distribution of Temperature with Depth through the Medicine Lake Highlands



Distribution of temperature (deg.F) with depth along Cross Section A-B, extending from northeast of Mt. Hoffman, southwest through the caldera. Names written vertically, above the section are geographic features near the line of the section.

Figure 3.4-4c: Distribution of Temperature with Depth through the Medicine Lake Highlands



Distribution of temperature (deg.F) with depth along Cross Section E-F, extending from Fourmile Hill southeast through the caldera. Names written vertically, above the section are geographic features near the line of the section.

manifestations (i.e., hot springs and fumaroles) outside of the caldera provides additional evidence that geothermal fluids are effectively isolated from shallow groundwater.

In the impermeable zone below the water table, heat originating in the geothermal system flows upward through the rock by conduction. After passing through the impermeable zone, the heat encounters the lower part of the overlying water table. Because of the rapid horizontal movement of cold groundwater through the water table, heat from the underlying reservoir is quickly conducted away and subsurface temperatures remain depressed in the shallow groundwater zone (shallow groundwater temperature in the Glass Mountain KGRA ranges from 36°F to 46°F). Consequently, temperatures within the impermeable zone are cooler near the top and increase rapidly with depth (i.e., the temperature gradient is very high).

Shallow groundwater within the caldera is probably separated from the shallow groundwater outside the caldera by shallow impermeability within the ring fracture system caused by alteration and mineral deposition. The geothermal system may be recharged from deep groundwater. It is probable that recharge to the geothermal system primarily occurs by deep lateral inflow at depths considerably greater than well 88-28. Some shallow groundwater recharge may occur via downward flow through fracture systems in the vicinity of the geothermal resource at Fourmile Hill in areas where permeability has not been restricted by hydrothermal alteration.

Figures 3.4-4a through 3.4-4c illustrate the temperature gradient throughout the Medicine Lake Highlands. Data from temperature gradient wells from throughout the region were used to create these illustrations (well locations are indicated by vertical lines and identified by well number). Figure 3.4-4b shows a cross-section of subsurface temperature distribution across the area in Figure 3.4-4a from point "A" to point "B." Figure 3.4-4c shows a similar temperature pattern for a cross-section from point "E" to point "F." These cross-sections span a distance of 10 to 11 miles, and each section begins and ends well outside of the margins of the caldera. In these figures, the surface topography is taken from USGS maps and contain no vertical exaggeration (i.e., the horizontal and vertical scales are identical). The contour lines indicate the elevation of temperature isotherms (isotherms are lines connecting points of identical temperature) below the surface to a maximum of 250°F (data are proprietary at higher temperatures at deeper depths).

Cross sections A-B and E-F in Figures 3.4-4b and 3.4-4c also demonstrate that the zone of low permeability (i.e., high-temperature gradient indicated by "bunching up" of temperature isotherms) underlying the groundwater zone is a feature that is found throughout the caldera and adjacent areas. The hydrogeology in the project area is therefore not unique to the project area. The cross sections also show that elevated temperatures are found at the highest elevations and shallowest depths along the ring fracture zone, which bounds the caldera. These data further substantiate the conclusion that the base of the groundwater saturated zone slopes radially outward, away from the caldera.

ALTERNATIVES

For geothermal resources, the affected environment includes the power plant and wellfield area, but does not include the transmission line routes. Therefore, the affected environment for Alternatives 2 through 6 would be the same as described for the proposed action since each of the alternatives would involve the same proposed power plant and wellfield.

3.5 Cultural Resources

INTRODUCTION

This section is designed to summarize the archaeological and historical setting of the study area, including the methodology of archaeological surveys conducted, the regional history of the study area, and the results of the archaeological surveys for the proposed action and the alternative transmission line segments. Traditional cultural values and ethnographic research is presented in Section 3.6, Traditional Cultural Values.

STUDY AREA

The study area for cultural resources includes the power plant location, all production and injection well pads, associated pipelines and access roads, and the proposed and alternate transmission line routes. For this discussion of the existing environment the study area is organized into three parts: the wellfield and power plant area, the freshwater pipeline, and the transmission line. The wellfield and power plant study area includes most of Section 28, T43N R3E, MDB&M and adjacent portions of the southeast quarter of Section 29 and the southeast quarter of Section 21. The freshwater pipeline study area consists of a 50-foot-wide corridor that runs approximately 4.9 miles southeastward from the proposed power plant location to a well in Arnica Sink. The proposed and alternate transmission line study areas consist of a 1,000-foot-wide corridor that is centered on the proposed and alternate alignments and extend from the proposed power plant to the proposed substation along the BPA Malin-Warner transmission line. The proposed and alternate transmission line routes are defined in Figure 2.3-1.

METHODOLOGY

Cultural Resource Studies in the Project Area

The information provided in this cultural resources existing environment section is summarized from the *Cultural Resources Sample Survey and Sensitivity Assessment for the Fourmile Hill Geothermal Project, Modoc and Klamath National Forests* report prepared by Far Western Anthropological Research Group, Inc. (FWARG 1996), and the 1998 addendum to that report. In addition to the background research and surveys FWARG conducted in the area, several reports on the study area were previously completed for Calpine Corporation and were used by FWARG to review and evaluate the archaeological resources of the study area. The reports used to provide information on the study area and to compile this section are listed below:

- *Biological and Cultural Resource Assessments for the Calpine Transmission Line Project,* prepared by S.J. Bianco and D. Sterner for Calpine Corporation, Santa Rosa, CA in 1996 (Bianco et al. 1996).
- *Supplemental Cultural Resources Study for the Calpine Geothermal Project within the Glass Mountain KGRA, Siskiyou County, California,* prepared by T.M. Origer for Calpine Corporation, Inc. Santa Rosa, CA in 1995 (Origer 1995).
- *An Archaeological Survey of Potential Temperature Gradient Hole Drilling Sites within the Glass Mountain KGRA, Siskiyou County, California,* prepared by T.M. Origer for Calpine Corporation, Inc. Santa Rosa, CA in 1994 (Origer 1994).

The information contained in this section is summarized from FWARG 1996, unless otherwise noted.

Prefield Research

FWARG compiled background research and record search information to identify previously recorded or known archaeological sites, as well as previous archaeological surveys conducted within the project area. The record search encompassed a study area of 134 square miles, and encompassed all aspects of the project area. This prefield research was used to augment information previously compiled by Bianco et al. (1996) in the *Biological and Cultural Resource Assessments for the Calpine Transmission Line Project* for approximately 44 percent of the current project area. Record searches were conducted by FWARG at the following archaeological repositories:

- Information Center, California Historical Resources Information System, California State University, Chico
- Goosenest Ranger District Office, Klamath National Forest
- Supervisor's Office, Modoc National Forest

Fieldwork

The fieldwork for this project was conducted on August 6-10, 1996, October 9 and 15, 1996, and July 21, 1998. Calpine personnel escorted FWARG archaeologists during the October 9 and 15 work episodes to ensure that the development areas affected by design changes were field checked. The type of sites identified correspond to the site type classification system presented in Gates (1989, revised 1996) and derived from Boynton et al. (1980) for the Modoc National Forest. The methodology used for surveys of the power plant area and transmission line corridors is described below.

Well Pads and Power Plant Site: Five well pads and the power plant site were surveyed by Origer in 1994 and 1995, and by FWARG in 1996 and 1998, using intervals of approximately 50 to 66 feet over an area approximately 528 feet in diameter. FWARG surveyed six additional well pads to complete the surveys required for the proposed action. These pads were also surveyed using 50 to 66 feet intervals; however, these pads typically measured 990 feet by 990 feet (22 acres). In total, 152 acres have been surveyed for pad sites (23 acres by Origer, and 129 acres by FWARG).

Corridors Connecting Well Pads: Proposed corridors (i.e., roads and pipeline routes) for connecting the well pads to the power plant site were flagged down the centerline and inspected in 50 to 60 feet intervals. Areas surrounding two road junctures were also surveyed, in anticipation that the intersections will need to be changed to accommodate heavy equipment. In total, nearly 140 acres were surveyed in association with proposed access roads, injection lines, and production lines.

Transmission Line Corridor Sample Segments: The analysis in this EIS/EIR addresses six potential transmission line routes, including the proposed action. It was determined in consultation with the Modoc and Klamath National Forests that a sampling survey methodology would be used to analyze the potential impacts of the proposed and alternate transmission line corridors. After a specific transmission line corridor is chosen, Class III intensive surveys will be conducted prior to construction. These

intensive pedestrian surveys will provide complete inventories of the cultural resources within the corridor that would contain the chosen transmission line route. This survey entails systematically walking the entire project area at 30 meter transects (distance between persons walking the site) and recording sites as found within the area.

For this EIS/EIR analysis, a total of 42 sample units were surveyed, distributed across the various transmission line segments and used to represent the transmission line alternatives (see Table 3.5-1). The impact zone corridor is proposed to be 125 feet wide. Field reconnaissance covered a wider strip than this impact zone. Each sample unit was 660 feet in length and 248 feet in width, and encompassed 3.75 acres each, resulting in coverage of a total of 182 acres. A representative variety of terrain and vegetation types were contained in each sample unit.

Table 3.5-1: Survey Sample Units by Transmission Line Corridor Segment

Segment	A1	A2	A3	B1	B2	C1	C2	Total
Length (in miles)	4.7	3.7	8.1	6.8	12.7	8.3	9.7	54.0
No. of Sample Units	6	3	5	7	4	9	8	42
Substations	-	-	-	-	-	-	1	2
Acreage Surveyed	22.5	11.3	18.8	26.3	15.0	43.8	44.3	182.0

SOURCE: FWARG 1996

Substations: The proposed project includes a substation at the eastern terminus of the transmission line. Alternatives 2 and 6 would include an alternate location for the substation at the eastern terminus. The surface disturbance required for the proposed and alternate substation would be approximately 360 feet by 360 feet (about 3 acres). FWARG crews intensively surveyed areas larger than the substation sites to allow flexibility for minor modification in location to avoid resources or accommodate engineering requirements. A total of 24.3 acres were surveyed.

Freshwater pipeline: The freshwater pipeline corridor was not surveyed by FWARG in 1996, but was surveyed by Origer in 1995. The freshwater pipeline corridor is approximately 31,560 feet long and 50 feet wide (36 acres). Origer completely surveyed the corridor using a zig-zag pattern of coverage within transects spaced less than 66 feet apart in a supplemental cultural resources study prepared for Calpine (Origer 1995).

REGIONAL OVERVIEW

Prehistoric

Existing archaeological evidence from the project vicinity suggests that humans have been active in the area for approximately the last 10,000 years. However, evidence of

cultural activity in the area dating from about 6,500 to 4,500 years ago is far more abundant and widespread than that of earlier occupations. Additional archaeological evidence indicates that land use and settlement patterns changed in the project vicinity through the years. Small, mobile hunter-gatherer populations that used temporary camps occupied the project area during the earliest periods; these groups did not depend on the storage of resources. Approximately 3,500 years ago, hunter-gatherer groups continued to be highly mobile in all seasons except winter. During the winter, small groups relied on stored resources, and moved their winter settlements from year to year within the study area. Although temporary settlements continued to be a vital component of the hunter-gatherer population, more complex and permanent human settlements began to develop in the area approximately 2,000 years ago; populations were dependent upon resource storage and returned to the same wintering grounds each year.

The project vicinity offered important obsidian resources to prehistoric populations. Archaeological evidence in the project area indicates that the peak consumption of Medicine Lake Highland obsidian occurred between approximately 3,500 to 1,000 years ago. This evidence is supported by distribution patterns of the same period of Medicine Lake Highland obsidian found throughout prehistoric sites in northern California and southern Oregon.

Different quarry areas within the Highland saw different levels of use or exploitation through time, a result of numerous factors such as toolstone quality, location, and availability. Prehistoric land-use and settlement patterns have also changed throughout the prehistoric period. Within the Modoc Plateau, the Modoc Uplands (or the east end of the project area) appears to have been an important hunting ground and of comparatively little importance for seed/plant processing, regardless of time period. When looking at prehistoric site assemblage contents and artifact diversity across time, however, it is apparent that the area was used increasingly for hunting, this in turn indicative of increased subsistence specialization. In the Early periods (10,000 to 3,500 years ago) the tool assemblages have a fairly even mix of a variety of flaked stone tools, which are tools made from rock fragments (e.g., scrapers, core tools, bifaces in various stages of reduction, simple flake tools, and moderate amounts of projectile points) and milling equipment in low but persistent quantities. In the Middle period (3,500 to 2,000 years ago) assemblages, milling equipment became more scarce, and the flaked stone tool assemblages shift such that early stage bifaces (rough-outs) are common in comparison to other kinds of flaked stone tools. Medicine Lake Highlands obsidian quarrying appears to have peaked during this interval, with surplus bifaces being manufactured in and around the quarry zones. These surpluses show up in prehistoric sites in the surrounding areas in northern California and southern Oregon, suggesting a developed trade system and/or an areally extensive subsistence settlement system. In later periods of prehistory (2,000 to 100 B.P.), there is little evidence that the quarries were exploited, but ample evidence of hunting. Late flaked stone tool assemblages contain hunting-related tools and little else.

Historic

During the nineteenth century, Euro-Americans considered the project vicinity to be an area to travel through, or cross, rather than settle (Bunse 1996 in FWARG 1996). Early

nineteenth century visitors were primarily composed of explorers and fur trappers. Transportation routes used during this period did not typically cross through the project area.

Euro-Americans that did visit the project area experienced hostile encounters with the Modoc Indians. Encounters with the Modoc deterred homesteading and settlement into the 1870s. In response to "Indian trouble", the U.S. military established Fort Bidwell in 1865. Modoc and Klamath Indians were soon forced to share reservation land. The Modoc left the reservation, and the Modoc Indian Wars of 1872-1873 resulted from the army's attempt to return them to reservations. A band of Modocs held off the U.S. military by hiding in the Lava Beds (Bunse 1996 in FWARG 1996). The band's leader, Captain Jack, and his followers were finally captured; Captain Jack was hung with three of his men at Fort Klamath in 1873. Dry Lake, which is traversed by transmission line corridor segment C2, is the location of one of the late skirmishes of this war. Even after the conclusion of the Modoc Indian Wars, Euro-American settlement in the area was slow and infrequent.

Railroad building and logging activities were the dominant activity in the project vicinity from the turn of the century until World War II. Railroad building began in the project area slightly before logging developments; logging soon followed in the late 1920s to support railroad construction. In January 1929, Southern Pacific Railroad began construction of the Modoc Line, which connects Alturas to Klamath Falls, Oregon, passing through the project area just a short distance east of Tionesta. In the late 1920's, the Long Bell Lumber Company and the Pickering/J.R. Shaw interest began logging cooperatively in the project area. In 1932, the Great Northern and Western Pacific Railroads opened their collaborative track connecting Klamath Falls to Keddie, California. This railroad passes through the east end of the project area, west of Tionesta. Lumber was shipped out of Tionesta via the Great Northern Railroad to Klamath Falls. A logging boom took place in Tionesta around 1940, but operations ceased by 1944.

Large scale commercial pumice mining began in the region in the 1930s. Throughout the 1930s and 1940s, pumice from the quarries in the Medicine Lake Highlands was shipped from Tionesta on the Great Northern Railroad. A pumice brick manufacturing plant was located at Tionesta beginning in the 1930s, but the plant relocated due to the abandonment of Tionesta by its inhabitants in the mid-1940s due to the halt of logging operations in the area.

Modern industrial use of the Medicine Lake Highlands is minor, and has been restricted primarily to railroad development, logging, and pumice mining from about 1920 to before World War II. This lack of development contributes to the area's current popularity for outdoor recreation (camping, hiking, fishing, hunting, etc.).

RECORD SEARCH OVERVIEW

The record search identified cultural resources in the study area that had been identified by previous researchers. The search results indicate that a total of 308 sites have been previously recorded within the study area, many as a result of in-house USFS inventories. The survey of three transmission line corridors, the California-Oregon Transmission Project (Jermann et al. 1989), the PGT/PG&E Pipeline Corridor (Moratto

1991a; 1991b; 1994, Moratto et al. 1988; 1990; and 1991), and the Tuscarora Pipeline Project (Delacorte et al. 1995; Price et al. 1994), which cross through the study area resulted in the identification of numerous other resources, and the related cultural resources studies provide considerable data regarding the prehistory of the Modoc Plateau, and characterization of the archaeological record in the eastern portion of the study area.

A total of 91 cultural resource sites are known to occur within 0.25 miles of the various transmission line segments (see Table 3.5.2). Of these, 73 are previously recorded sites, 13 are unrecorded historic-era resources identified as a result of map reviews previously performed, and 5 are unrecorded historic-era resources identified through the review of a historic atlas on file at the Modoc National Forest Service Office. Of these 91 sites, 8 have been formally evaluated under the National Historic Preservation Act and have been recommended as eligible for the National Register of Historic Places (NRHP). Five of the eligible sites are prehistoric properties, one of which is likely associated with the Battle of Dry Lake (1872-1873). Two are historic properties, consisting of a grave and the Modoc Northern Line of the Southern Pacific Railroad. One site had both historic components and complex temporary camps, and was determined eligible based only on its prehistoric components.

The record search showed that a total of 233 sites have been recorded within the 134 square mile cultural resources study area and more than 0.25 miles from the various transmission line segments. Formal evaluations have been completed for 12 of these sites, and each was concluded to be eligible for the NRHP.

PROPOSED ACTION (ALTERNATIVE 1)

This section describes the cultural resources that have been identified in the project area as a result of FWARG's record search and field sample surveys. Information obtained from the record search that pertains specifically to the proposed action is summarized.

Prehistoric Resources

One prehistoric quarry was identified in the wellfield and power plant area (FS# 05-05-57-1040). This unevaluated prehistoric quarry corresponds to an explosion crater in the area. Small quantities of prehistoric quarrying debris extend across the site area a small distance into the surveyed corridor. No prehistoric cultural resources sites were identified along the freshwater pipeline corridor in previous research conducted by Origer 1995 (see Table 3.5-3).

Eight prehistoric sites were identified along the proposed transmission line segments A1, A2, B1, and C1 (see Table 3.5-4). One of the prehistoric sites (56-2312) is located along segment A1, and seven of the prehistoric sites are located along segment C1 (56-2313-2319). The prehistoric site located along segment A1 is a simple lithic scatter (i.e., it contains no more than one discernible concentration of obsidian chipping debris).

The seven sites located along segment C1 include four simple lithic scatters and three moderately complex lithic scatters (i.e., they contain three or four concentrations (loci) of chipping debris). A highly complex temporary camp (MOD-1718/1719/1720H complex), located along segment C1, has been identified as both a prehistoric and

Table 3.5-2: Number of Previously Recorded Sites by Type, Within 0.25 Mile of Proposed and Alternate Transmission Line Corridor Segments

Segment	Length in Miles	Prehistoric	Historic	Prehistoric & Historic	Unknown Historics	Historic Atlas	Total
A1	4.72	2	-	-	-	-	2
A2	3.67	-	-	-	-	-	-
A3	8.17	-	2	-	1	-	3
B1	6.78	6	-	-	9	1	16
B2	12.74	8	-	-	-	-	8
C1	8.27	11	2	3	2	3	21
C2	9.66	29	8	6	-	2	45
Total	54.01	55[a]	10[b]	9	12	5[c]	91

Notes:

[a] MOD-1458 is near both segments C1 and C2;

[b] MOD-3096H and 2069H/Tichnor Road is near both segments C1 and C2;

[c] All "patented" areas (H-15 and H-18 on Caldwell Butte quad; H-17 on West Kephardt quad, and H-8, H-10, H-11, and Potters Allotment on the Perez quad) were eliminated; areas referenced as the Dry Lake Administration Site (H-3), the Straw Post Office (H-4), the Dry Lake Ranch (H-5), and the Dry Lake Guard Station (H-5) on the Perez quad have been eliminated, since it appears they are misplotted; H-1, the Emigrant Road, is near both segments C1 and C2.

SOURCE: FWARG 1996

Table 3.5-3: Cultural Resources Sites Identified Within the Proposed Project Area

	Prehistoric Sites	Historic Sites	Both	Total
Wellfield and Power Plant Area	1	1	-	2
Freshwater Pipeline	-	-	-	-
Segment A1	1	1	-	2
Segment A2	-	-	-	0
Segment B1	-	-	-	0
Segment C1	7	-	1	8
Total	9	2	1	12

SOURCE: FWARG 1996, ORIGER 1995

Table 3.5-4: Sites within Survey Sample Units or Crossed by Proposed and Alternate Transmission Line Corridor Segments

	SEGMENT (see Figure 2.3-1)						
Sites	**A1**	**A2**	**A3**	**B1**	**B2**	**C1 and Substation**	**C2 and Substation**
Sites Discovered Within Sample Units	56-2312 56-2310H	--	P104H	--	--	56-2313 56-2314 56-2315 56-2316 56-2317 56-2318 56-2319 *MOD-1718/H*[c] *Complex*	56-2320 56-2321 56-2322 *MOD-1706*[a] MOD-1853 *MOD-2562/2563*[b,c] MOD-2919
Previously Recorded Sites Crossed by Transmission Line Corridor, Outside of Survey Sample Units	--	--	--	MOD-2340 Long Bell, (H-16cld, H20wkep)	MOD-1210 SIS-675	56-1939 MOD-1390 MOD-2943 *MOD-3096H*[c] Emigrant Rd. Tichnor Rd. Cox Patent Potters Allot.	MOD-1455H MOD-2335/H MOD-2977H *MOD-3096H*[c] Emigrant Rd. Tichnor Rd. Stock Drive (H-15prz) Lauer Patent Potters Allot.
Prehistoric Quarry Zones Previously Identified	--	Glass Mtn. (to southeast)	--	Glass Mtn. (to south) East Medicine Lake (to north)	E. Glass Mtn. (to northwest) East Medicine Lake (to west)	--	--

Notes:

[a] Includes MOD-2959

[b] Appears to include FS 56-7, Dry Lake battle site *I*

[c] *Italics* denote site previously determined significant.

SOURCE: FWARG 1996

historic site, and has been determined eligible for the NRHP based on its prehistoric components. The MOD-1718/1719/1720H complex covers in excess of 3.3 million square feet and contains 15 loci. The site exhibits a high debitage density in many of its loci, and materials have been identified from several different periods.

Segments A2, B1, and C1, may be located adjacent to or cross prehistoric quarry zones. Prehistoric quarry zones have been previously identified in the study area. Four poorly documented prehistoric obsidian quarry zones have been recorded slightly more than 0.25 miles from the transmission line corridor segments. The potential exists for the proposed segments to cross these zones. The edges of the Glass Mountain flow(s) and the surrounding border have not been thoroughly inventoried, and the actual extent and location of prehistoric quarries around the Glass Mountain flow and within the Medicine Lake Highland remain poorly documented.

The Glass Mountain Quarry Complex has been drawn along the north and west facing edge of the Glass Mountain Flow to the southeast of transmission line segment A2. A separate obsidian exposure on the north face of the Glass Mountain Flow (corresponding to the Glass Mountain source locality of the Glass Mountain Chemical Group and source locality [Hughes 1983:319 in FWARG 1996]) lies south of transmission line segment B1. In addition, the matchpoint segments B1 and C1 lies to the east-southeast of the poorly documented East Medicine Lake quarry zone.

Record search results also indicate that segment B1 crosses a prehistoric rock alignment feature (MOD-2340). Segment C1 crosses three lithic scatters (56-1939, MOD-1390, MOD-2943).

Historic Resources: In the wellfield and power plant area, one site (P104H) was identified that appears to correspond to a portion of the Long Bell Railroad System that may have been constructed after about 1920. The portion of this linear site that extends into the plant site vicinity corresponds to FS Road 44N64, and occasionally individual historic artifacts can be found along the side of the road. The site has not been formally evaluated, but its current use as a Forest Service road suggests that the portions noted within the plant site area no longer have sufficient integrity to be considered eligible for the NRHP. No historic resources were identified along the freshwater pipeline in previous research conducted by Origer in 1995.

Two historic sites have been identified along the proposed transmission line segments. One small can dump is located along segment A1 (56-2310H). The highly complex temporary camp (MOD-1718/1719/1720 complex) that is classified as both a prehistoric and historic site is located along segment C1, and in 1993 the historic component was determined not eligible for the NRHP.

Record search identified previously recorded historic sites along the proposed transmission line segments. Segment B1 may cross portions of the Long Bell Railroad. A previously recorded historic site, the eligible Modoc Northern Line of the Southern Pacific Railroad (MOD-3096H) was identified within the segment C1 corridor. Unverified portions of Emigrant and Tichnor Roads may also be located along segment C1. Segment C1 crosses a land claim patented in 1911, the Cox patent, as well as the Potters Allotment. It is not known if these patents contain cultural historic-era resources.

ALTERNATIVES

As discussed at the beginning of this chapter, the following section describes the affected environment for each alternative to the proposed action. For Alternatives 2 through 6, the affected environment for the proposed wellfield and power plant site, as well as the proposed freshwater pipeline, would be the same as described for the proposed action since these facilities would be the same for Alternatives 1 through 6. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of existing environment along these portions of the transmission line are not repeated under each alternative discussion. The description of the affected environment focuses on the segments of the transmission line that would be different from those in the proposed action. The reader is also referred to Tables 3.5-2 and 3.5-4.

Alternative 2 (A1, A2, B1, and C2)

Under Alternative 2, transmission line segment C2 would replace segment C1. The affected environment for the power plant and wellfield area, and transmission line segments A1, A2, and B1 would be the same under this alternative as described above for the proposed action. The existing environment along segment C2 for cultural resources is described below.

Segment C2: Cultural resources sites identified along segment C2 consist of seven prehistoric sites (56-2320-2322, MOD-1853, MOD-2919). These sites include two simple lithic scatters, three moderately complex lithic scatters (two with three loci, and one with nine loci and a few features), and two highly complex temporary camps that have previously been determined eligible for the NRHP (MOD-1706, MOD-2562/2563).

MOD-1706 is a temporary camp that covers in excess of 125 acres and contains 15 loci. Surface examinations in 1993 and 1994 resulted in identifying loci that range in size from 31,065 square feet to 4,360 square feet; average debitage densities for two of the loci were characterized at 10-20 flakes per 10.9 square feet (1 square meter) within loci. The five loci discovered during surveys for this project range in size from 9,276 square feet to 3,139 square feet, and have maximum densities estimated at 6 flakes per 10.9 square feet (1 square meter) to 14 flakes per 10.9 square feet (1 square meter).

Portions of MOD-2562/2563 are likely temporary camps affiliated with the Battle of Dry Lake, part of the Modoc Wars (1872 to 1873). Nearly 300 artifacts have been recovered from this site in previous research, in addition to about 25,000 pieces of debitage. The site appears to have been occupied during three different intervals. Four basalt features were recorded in the northernmost portion of the site (i.e., MOD-2563) that may have served as fortifications or lookouts during the Battle of Dry Lake.

Three isolated finds were identified during the sample survey for segment C2; they include: one obsidian flake tool, five unmodified obsidian flakes within a 16.5 by 16.5 square foot area, and one crudely worked side-notched dart point of obsidian.

Record search results indicate that segment C2 contains one combined prehistoric and historic site (MOD-2335H) that displays railroad grade segments and attendant features, as well as a simple lithic scatter, and additional historic sites. The historic sites include a small can dump less than 50 years old (MOD-1455H), a pre-1928 road segment

(MOD-2977H), and a portion of the eligible Modoc Northern Line of the Southern Pacific Railroad (MOD-3096H).

Unverified portions of Emigrant and Tichnor Roads, a stock-drive trail in use prior to 1939, and portions of the Long Bell Railroad may be located along C2. These four purported sites have not been ground-truthed (field-verified) within the transmission line corridors, but portions of Tichnor Road have been documented elsewhere within USFS land. Additional survey work within the transmission line segments is likely to encounter portions of these resources.

Segment C2 also crosses the Lauer land claim patented in 1911, as well as the Potters Allotment. The Modoc National Forest Historic Atlas depicts a parcel west of the intersection of S.R. 139 and County Road 136, designated as the Dry Lake Administration Site, which contains smaller areas labeled as the Straw Post Office, the Dry Lake Ranch, and the Dry Lake Guard Station. It is not known if these patents or the Dry Lake Administration parcel contain historic-era cultural resources.

Segment C2 may be located adjacent to or cross prehistoric quarry zones. The matchpoint of transmission line segment B1 and C2 lies to the east-southeast of the poorly-documented East Medicine Lake quarry zone.

Alternative 3 (A1, B2, and C1)

Under Alternative 3, transmission line segment B2 would replace segments A2 and B1. The affected environment for the power plant and wellfield area, and transmission line segments A1 and C1 would be the same under this alternative as described above for the proposed action. The existing environment along segment B2 for cultural resources is described below.

Segment B2: No prehistoric or historic cultural resources sites were identified along segment B2 through surveys conducted in the sample units. The record search showed this segment crosses through two previously identified lithic scatters (MOD-1210, SIS-675).

Segment B2 may be located adjacent to or cross prehistoric quarry zones. An obsidian exposure, exploited prehistorically, occurs on the east edge of the Glass Mountain Flow (corresponding to the East Glass Mountain Chemical Group and source locality [Hughes 1983:321 in FWARG 1996]), lying northwest of transmission line segment B2. The matchpoint of transmission line segment B2 lies to the east-southeast of the poorly documented East Medicine Lake quarry zone.

Alternative 4 (A1, B2, and C2)

Under Alternative 4, transmission line segment B2 would replace segments A2 and B1, and segment C2 would replace segment C1. The affected environment for the power plant and wellfield area, and transmission line segment A1 would be the same under this alternative as described above for the proposed action. Existing conditions along segments B2 and C2 are described above under Alternatives 3 and 2, respectively.

Alternative 5 (A3, B1, and C1)

Under Alternative 5, transmission line segment A3 would replace segments A1 and A2. The affected environment for the power plant and wellfield area, and transmission line

segments B1 and C1 would be the same under this alternative as described above for the proposed action. The existing environment along segment A3 is described below.

Segment A3: One historic site was located along segment A3 (P104H). This site appears to correspond to a portion of the Long Bell Railroad System that may have been constructed about 1920. Segment A3 also contained a resource with historic, post-World War II features or materials that were noted but not formally recorded during surveying inventory. Noted but not recorded resources are features or materials that do not meet the State of California Office of Historic Preservation's criteria for an archaeological site. No prehistoric cultural resources sites were identified along segment A3.

Alternative 6 (A3, B1, and C2)

Under Alternative 6, transmission line segment A3 would replace segments A1 and A2, and segment C2 would replace segment C1. The affected environment for the power plant and wellfield area, and transmission line segment B1 would be the same under this alternative as described above for the proposed action. Existing conditions along segments A3 and C2 are described above under Alternatives 5 and 2, respectively.

Alternative 7 (No Action)

The setting for Alternative 7, the No Action alternative would be the same as for the proposed project.

3.6 Traditional Cultural Values

INTRODUCTION

The proposed project area has been traditionally used by several local tribes, including the Klamath, Pit River, and Shasta Tribes. (The term "Klamath Tribes," used throughout this section and this EIS/EIR, refers to the current political organization of the American Indian group consisting of the Klamath and Modoc tribes, and the Yohooskin band of Snake Indians.) The Medicine Lake Highlands and the Modoc Plateau are important to tribal members for traditional and spiritual uses. Local tribes were consulted and individual tribal members were interviewed to identify specific sites important to the local tribes, and to determine potential project effects on these sites. This section describes the tribal consultation process that has been conducted to date, including the ethnographic study conducted for the proposed project. This section also describes the ethnographic setting of the project area, traditional and contemporary uses of the Medicine Lake Highlands, and tribal concerns about the proposed project.

The format of this section deviates from that of other sections as the setting is described on a regional basis and applies to the proposed project and all alternatives. This regional approach is responsive to tribal concerns.

STUDY AREA

The proposed project would include project facilities in the Medicine Lake Highlands with a transmission line extending from the Medicine Lake Highlands to the east of the Malin-Warner transmission line near Tionesta on the Modoc Plateau. The study area was designed to include the areas of potential direct and indirect effects for the placement of the proposed power plant, well pads, pipeline, and transmission line on the Calpine leases in the Highlands. The study area includes the corridors for construction of the proposed transmission line and the alternative transmission line routes (see Figure 2.3-1). Local tribal members have expressed concern about the effects of a project in the Medicine Lake Highlands and surrounding areas, due to current, historical, and prehistoric use of the project region by native peoples. The study area for this impact analysis therefore includes the Medicine Lake Highlands and a corridor bounded by the proposed and alternative transmission line routes.

METHODOLOGY

The traditional cultural values of the project region were identified through a process similar to and in the spirit of government-to-government consultation, although not formalized as such. This process included meetings with local American Indian tribes. Site visits, literature review, and interviews with members of local tribes were conducted by the EIS/EIR team ethnographer, Dr. Dorothea Theodoratus. The data collection and evaluation phases of the tribal consultation process is continuing (see below).

Project Meetings

The USFS, Modoc National Forest, and the BLM, Alturas Resource Area Office, are currently working towards establishing government-to-government relations with local American Indian tribes as part of the environmental review process for the proposed

Calpine geothermal power plant project. The proposed project and the parties involved in the government-to-government consultation process for this project and other development in the Glass Mountain Known Geothermal Resource Area (KGRA) are described further in a report prepared for this project, entitled *Consultations with the Pit River Nation, Klamath Tribes, and the Shasta Tribe* (MHA Environmental Consulting, Inc. 1998). Table 3.6-1 summarizes American Indian consultations that have been conducted to date for the proposed project.

The USFS and BLM are both involved in the consultation process because the environmental review is being jointly conducted by the two agencies, and because they have jurisdiction over lands that are of interest to the tribes. The BLM is responsible for the geothermal lease operations, and the USFS is responsible for the protection of surface resources and designation of a transmission line corridor.

Local American Indian tribes were notified of the proposed project during preliminary planning activities, and in advance of notification to the general public. Advance notification of the tribes was undertaken to ensure that local tribes were provided with ample opportunity to express their concerns, and to allow time for their concerns to be addressed. Prior to the public scoping process for the proposed geothermal project, four meetings were conducted with tribal members. Three meetings were held with tribal groups during the scoping process for the proposed project; written comments from tribes also were received during this period. Both the Pit River Nation and the Klamath Tribes are opposed to the proposed project. Five meetings with the tribes were held subsequent to the distribution of the Draft EIS/EIR.

Interviews also were conducted with individual tribal members (see below) and a report (Theodoratus et al. 1998) was prepared to document the information gathered in the interviews. The report was provided to the Pit River and Klamath Tribes in March 1997. The USFS/BLM held meetings with the tribes in June 1997 to obtain comments on the report and to discuss the information that could be included in the Draft EIS/EIR. Consultations with the tribes will continue throughout the environmental review process.

Literature Review

The ethnographic study for the proposed project included a literature review conducted by Theodoratus and Emberson (1996; Theodoratus et al. 1998) to provide additional ethnographic information and to present data previously collected about the local indigenous peoples that once inhabited and still use the Medicine Lake Highlands and Timber Mountain Areas. Theodoratus and Emberson collected data at:

- California State University, Sacramento Library
- State of California Library, Sacramento
- Researcher's private collection
- USFS archaeological and ethnographic site records from the Klamath, Modoc, and Shasta-Trinity Forests

Table 3.6-1: Summary of American Indian Consultations for the Proposed Project

Tribe	Agency/Company	Date	Type of Consultation
Klamath Tribes, Shasta Group	USFS	October 27, 1995	Meeting
Klamath Tribes, Shasta Group	USFS, BLM, Calpine	December 7, 1995	Meeting
Pit River Tribes	USFS, BLM	April 15, 1996	Meeting
Pit River Tribes	USFS, BLM, Calpine	April 19, 1996	Presentation
Klamath Tribes	USFS, BLM, MHA	June 13, 1996	Meeting
Klamath Tribes	USFS, BLM, MHA	July 10, 1996	Meeting
Pit River Tribes	USFS, BLM, MHA	July 12, 1996	Meeting
Klamath Tribes, Pit River Tribes, Shasta Tribes	Theodoratus (MHA)	August 10-23, 1996	Interviews
Pit River Tribes	USFS, BLM	September 28, 1996	Site Visit
Klamath Tribes	USFS, BLM	June 5, 1997	Meeting
Klamath Tribes	USFS, BLM	June 17, 1997	Meeting
Pit River Tribes	USFS, BLM	June 20, 1997	Meeting
Klamath Tribes	USFS, BLM, MHA	August 6, 1997	Meeting
Klamath Tribes, Pit River Tribe	Theodoratus (MHA)	September 9-13, 1997	Site Visits/Interviews
Pit River Tribe	USFS, BLM	October 3, 1997	Meeting
Klamath Tribes, Pit River Tribe	Theodoratus (MHA)	October 6-11, 1997 and October 26-29, 1997	Site Visits/Interviews
Klamath Tribes, Pit River Tribe	Theodoratus (MHA)	November 2-4, 1997	Interviews
Pit River Tribe	Theodoratus (MHA)	December 5, 1997	Interview
Pit River Tribe	USFS, BLM	March 17, 1998	Meeting
Klamath Tribes	USFS, BLM	April 1, 1998	Meeting
Pit River Tribe	USFS, BLM	April 10, 1998	Meeting

SOURCE: MHA Environmental Consulting, Inc. 1998

Interviews

During the tribal consultation for the proposed project, it was determined that individual interviews with local tribal members would be the most effective method for gathering information about American Indian uses of the project area and tribal concerns associated with the proposed project. The concerns expressed at meetings held with both the Klamath Tribes Cultural Heritage Committee and with the Pit River Tribal Council were taken into consideration and the advice offered by the tribes on

research procedure was integrated into the field methodology for interviews. It was determined at these meetings that tribal consultants would be reimbursed for their time (by Calpine, the geothermal project proponent) and that they would receive a copy of their own interview notes for correction and clarification by the consultants.

It was agreed that the Klamath and Pit River Tribes would have the opportunity to review the research report for corrections and additional input. The *Draft Ethnographic Report* (Theodoratus and Emberson 1996) and summary of consultations (MHA Environmental Consulting, Inc. 1996) were submitted to the tribes for review and comment.

The purpose of interviews conducted by Dr. Dorothea Theodoratus was to collect data from tribal members on the project area that would describe historic and current tribal uses and to identify project effects. Further information on the interview procedure and results is located in the *Ethnographic Report* prepared by Dr. Theodoratus (Theodoratus et al. 1998). The interviews were conducted over a two-year period and were designed to:

- Assist in the lead agencies' government-to-government consultation with the tribes,
- Identify traditional cultural properties that could be affected by the proposed project, and
- Determine the impacts of the proposed project on American Indians and their use of the project area.

Interview Procedure: A total of 31 interviews were conducted by Dr. Theodoratus for the proposed project, with the interview procedure the same for all groups. Persons consulted were provided with a copy of *Background Information on Proposed Geothermal Activities Within the Glass Mountain KGRA,* which included a map showing landscape features within the "Fourmile Hill Geothermal Project" area, to assist them in the consultation. The researcher described the project area with the project map as a point of reference. Each consultant was also provided an *Ethnographic Consent Form; Use of Medicine Lake Highlands and Timber Mountain Areas.* The Consent Form provided consultants with options concerning the listing of their names on a consultant list, the disposition of data in the report, and the use of their names on the interview notes. Most consultants agreed to permit their names on a list of persons interviewed for this study. Table 3.6-2 shows the group affiliation for the 28 persons consulted for this study.

The consultant was asked about his/her general knowledge related to the area. This general knowledge would include elements such as:

- Topographical features and their significance (e.g., mountains, buttes, lakes, Medicine Lake Highlands area)
- General uses of such features
- Time of year for use
- Any associated historic events
- Delineation of tribal boundaries in the area

Table 3.6-2: Affiliation of Persons Interviewed

	Phase I	Phase II	
Pit River Nation/Bands	11	4	2[a]
Unknown	1		
Ajumawi	4	1	1[a]
Atwamsini	2	1	
Astariwawi	1	1	1[a]
Madesiwi	1	1	
Hammawi	1		
Aporige	1		
Klamath Tribes	9	1[a b]	
Shasta	4		
Total Interviews	24	4	3[a]

[a] Previously interviewed

[b] Especially Modoc

SOURCE: Theodoratus et al. 1998

After general discussion, the interviews then turned to focus on specific sites of interest and the qualities of these sites which make them special (e.g., Medicine Lake, Timber Mountain, Glass Mountain). Amplification was asked for specific task use areas (e.g., hunting, gathering, spiritual). Consultants were asked about their ideas regarding the proposed project. At the conclusion of the interview they were again asked if they had any additional thoughts.

Pit River and The Klamath Tribes: The interviews with members of the Pit River and Klamath Tribes were initiated during August 1996 when Dr. Theodoratus traveled to northeast California and southern Oregon to speak with consultants about their cultural knowledge of, and concerns for, the project area. Personal interviews with Pit River people in northeast California were conducted in the presence of a Tribal Council member in one case, and in all other cases with the presence of and assistance of the Pit River Tribal Council's Cultural Resource Officer. Those tribal members who were unavailable for personal contact made themselves available by telephone. The Klamath Tribes appointed a Site Protection Technician to be in charge of the research with their tribal members. It was determined that a person of Klamath or Modoc ancestry (Tribal Assistant) would assist the researcher and attend all interviews with Klamath and Modoc consultants. A list of possible consultants was developed through the combined efforts of the Site Protection Technician, the Cultural Resource Officer, and Dr. Theodoratus. The Tribal Assistant arranged the interviews and assisted in the process.

Numerous attempts were made to conduct additional interviews. In the case of Pit River peoples, several individuals chose not to comment because the proposed project is not within their perceived band boundaries. In general, comments were made in support of the Achumawi and Atwamsini bands (under whose tribal jurisdiction the project area is located), and their desire to protect their spiritual sites and activities.

Shasta Tribe: During a reconnaissance survey in July, the project team visited with a Butte Valley Shasta Tribal member who suggested contacting the Shasta people at Quartz Valley at Fort Jones. During field interviews with Pit River, Klamath, and Modoc peoples it was also suggested that Shasta people be informed of the project. In addition, the literature review indicated that, although Shasta territory is peripheral to the project, the Shasta people traditionally used the project area for obsidian procurement and participated in active trade with project area tribes. The next Shasta contact effort was by phone. Letters (including project information) were sent to two suggested individuals and to the Quartz Valley Indian community. These letters outlined the areas of concern in the same way the personal interviews were conducted, from general to specific. Phone calls followed the letters; an additional consultant was suggested, and this consultant was also contacted.

ETHNOGRAPHIC SETTING

Literature Review

Ethnographic information that was obtained through literature review on the Pit River and Modoc Tribes is summarized below. This information is intended to provide an understanding of the American Indian current and historic uses of the project region. More detailed ethnographic information is contained in the *Ethnographic Report* (Theodoratus et al. 1998), from which the text below was summarized.

Pit River Overview: The Pit River Nation consists of 11 bands, many of whom reside in their traditional ethnographic territory in northeastern California. These bands are divided into two major groups: the Achumawi whose territory is along the Pit River, and the Atsugewi who lived along Hat Creek and in Dixie Valley. Because of the location of their territory, the Achumawi group is of particular concern for this project, and especially the Ajumawi and Atwamsini bands of the Achumawi group.

Pit River people were intimately and spiritually involved with their physical environment, and the landscape of their territory played an intricate role in their history, mythology, cultural patterns, and social system. Many of the geologic sites formed by volcanic action in the Medicine Lake Highlands area are known to hold spiritual significance for past and present day Pit River peoples. The entire Highlands area consists of domes (e.g., Glass Mountain), lava and obsidian flows (e.g., Glass Mountain Geologic Area), and volcanic prominences, such as Glass Mountain and Little Glass Mountain. Other types of landscape features that figure prominently in the culture, history, and religion of the Pit River peoples as well as neighboring groups include springs and caves (e.g., Yellowjacket Ice Cave, Paynes Springs), as well as a variety of other environmental features.

Historically, the Indian people in northeast California/southern Oregon cooperated in trading ventures and shared certain geographical areas for hunting, fishing, gathering, and other procurements (e.g., obsidian). Such intertribal use is historically documented for the Pit River peoples' Medicine Lake Highlands, rich in raw materials, such as obsidian. Other groups obtained obsidian here and some traded it over great distances to other tribal groups (Kniffen 1928; Kroeber 1925; Olmstead and Stewart 1978).

The cultures of the Pit River Nation and neighboring tribes were greatly affected by non-Indian entry and settlement in their territories; non-Indians brought disease, engendered mutual hostilities between Indian people and settlers, and killed or displaced Indians. However, some Indians remained in their traditional areas and many of those displaced later returned. Thus, Pit River peoples continued to reside in their traditional tribal territory, working through the years as wood cutters, day laborers, housekeepers, basket makers, and house servants.

Modoc Overview: The Modoc Tribal territory encompasses parts of southern Oregon and northeast California. The Modoc people, located south of the Klamath people, ranged across what is now the Oregon-California border to the western side of Goose Lake. The series of peaks between Mt. Shasta and Glass Mountain in the south (Ash Creek Butte, Rainbow Mountain, Fisk Ridge) were a recognized natural boundary between the Modoc and the Pit River Tribes (Barrett 1910; Ray 1963). North from Mt. Shasta, the Cascade Range divided the territories of the Modoc and the Shasta Tribes (Silver 1978:211).

Religion for the Modoc was an integral part of daily life, and was linked to the land through a variety of practices and beliefs. These religious practices and beliefs included individuals' personal crisis quests, spiritual communications between individuals and elements of their environment, a variety of myths (many of which are closely tied to specific locales), ritual centers located throughout Modoc territory, cremation sites located near Modoc occupation sites, and the ideology and practice incorporated in shamanism and doctoring.

Similar to the Pit River, the Modoc generally cooperated with neighboring tribes to trade for food, manufactured items, and raw materials. Trade routes crossed the area, and networks introduced goods from distant tribes. The Modoc obtained horses at The Dalles (Oregon) and traded them to the Achumawi (Davis 1974:15-32). Intertribal conflicts also occurred, however, and the Modoc raided Pit River groups for slaves that they traded to the north (Davis 1974:29; Howe 1979:199; Kniffen 1928:312).

Non-Indians began to intrude into Modoc territory in the 1840s, and newly established trails brought settlement into the area after 1860. Armed conflicts were a result of non-Indian settlement, and finally resulted in the Modoc War (1871-1873), during which a small band of Modoc held the U.S. Army at bay in the Lava Beds for several months. The warring Modoc were finally captured, several were hanged, and most of the surviving Modoc people were forcefully relocated to Oklahoma. Several returned to the area and settled mostly on the Klamath Reservation where Modoc consultants say they were confined for many years (Barrett 1910; Stern 1965; Field Data).

Tribal Interviews

As described above, 31 interviews were conducted with representatives of the Pit River, Klamath, and Shasta Tribes. A great deal of ethnographic data was obtained through the interviews. Tribal consultants provided information on sites in the region that are important to American Indians for traditional, spiritual, and religious practices. The tribal members provided information on both traditional and contemporary uses in the area. Information on project effects on tribal members and traditional practices was also gathered (see below).

The data gathered in the interviews are presented in the confidential *Ethnographic Report* (Theodoratus et al. 1998). The following sections describe some of the information obtained in the interviews.

TRADITIONAL AND CONTEMPORARY USES

Traditional Uses

As shown through the ethnographic research conducted for the project (Theodoratus et al. 1998), the areas have historic importance as traditional use areas for the Pit River Bands, Klamath peoples, and peripheral tribes. These cultural properties have been an integral part of these tribal cultures from prehistoric time to the present. The culturally sensitive traditional use areas are each composed of known localities for hunting and gathering, mineral/rock resources, social interactions, and medicinal/spiritual purposes, both historically and for present-day tribal peoples. Mythological features are also displayed on the landscape, and many of the landscape features represent boundary markers. These properties are shown, as a result of the research, to have had on-going use by Pit River Bands, the Klamath Tribes, and adjacent groups for important cultural activities, including social/spiritual endeavors. This use predates the arrival of Euro-Americans in the area and has continued to the present time.

The contemporary use of the project region by tribal members has been documented through consultations and meetings between the USFS and local tribes for other projects, such as the Modoc Volcanic Scenic Byway and the previous geothermal exploration activities. Contemporary uses include religious ceremonies, gathering, and personal spiritual activities.

TRADITIONAL SITES

Tribal consultants identified a number of geographic locations with traditional and contemporary importance. As part of the review of the project, these sites would be further defined, and if appropriate, evaluated through the Section 106 process of the National Historic Preservation Act for eligibility for listing on the National Register of Historic Places.

Documentation

For consideration for National Register of Historic Places eligibility, historic properties are subject to the Section 106 process, but there are differences in how the process is carried out (see National Historic Preservation Act of 1966, as amended (16 U.S.C. sect. 470)). The uniqueness of identifying and evaluating traditional cultural properties involves the procurement of specialized knowledge that is maintained within the traditional native community. Although traditional cultural properties may have physical manifestations that can be seen by anyone, there are other qualities attached to these physical features that are less apparent to an uninformed outsider. The meaning and importance of these elements of traditional cultural properties can only be evaluated in terms of the oral history of the community to which they are significant. To identify and evaluate traditional cultural properties requires obtaining information from knowledgeable members in the communities whose traditional use areas will be affected by an undertaking. The research data obtained to date through tribal interviews present evidence that demonstrate the area should be considered against

National Register of Historic Places Traditional Cultural Property criteria. These data obtained to date combine published and unpublished documents on local tribes and present-day consultation with tribal descendants for verification of historic continuity of traditional use.

The research conducted by Theodoratus and Emberson (1996) was the first phase in the identification and evaluation of traditional cultural properties in the study area. Additional research was conducted to verify cultural use of the sites in the field. The additional research included further literature search, site visits and field verification, and additional interviews with the tribal members. The sites were recorded on Standard California State Site Survey form (or USFS form) and USGS quadrangle maps. Sites were also photographed.

Eligibility

The sites located in the area, according to the relevant criteria outlined in the National Park Service Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, need to be defined and evaluated as to their eligibility for the National Register of Historic Places. Evaluation of such properties relies on guidance provided in Federal Regulations relative to the National Register's *Criteria for Evaluation* (36 CFR Sect. 60.4) and Bulletin 38, both of which are developed through the provisions of the National Historic Preservation Act of 1966, as amended (16 U.S.C., sect. 470).

Federal guidance stresses the need for well-documented evidence of continuing traditional use within a tangible, clearly defined geographic area. The National Register outlines specific criteria for eligibility. These criteria range from "association with the lives of persons significant in our past" to the "potential to yield information important in prehistory or history." Criteria include ensuring that the entity under consideration is a tangible property, that the property has maintained integrity, that the property is associated with broader patterns of history and has the potential to yield important prehistoric and historic information, and that these elements have more than a fifty year time depth. Traditional use areas that are important to a specific group of people could be considered for eligibility for the National Register of Historic Places under criterion "a": association "with events that have made a significant contribution to the broad patterns of our history" (sect. 60.4). A definition of a traditional cultural property may be found in Bulletin 38, as a property that is "eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community."

The ethnographic study (Theodoratus and Emberson 1996; Theodoratus et al. 1998) provides historic and contemporary evidence for potentially eligible traditional cultural properties. Additional information about sites that is collected in on-going research can also be used to determine the potential eligibility of sites as traditional cultural properties.

Integrity: Bulletin 38 addresses the need for a traditional cultural property to have "integrity of location, design, setting, materials, workmanship, and association" in order to be considered eligible as a traditional cultural property. Of particular concern is the association with a group's traditions, that is, the association with beliefs or practices

that are important in maintaining the group's cultural identity. A major concern is whether or not the property has been so altered by recent events that it has lost its significance in the eyes of the community that once valued it. Evidence in the Ethnographic Report (Theodoratus et al. 1998) addresses traditional activities in these areas. The physical characteristics of the area remain culturally significant, although slightly altered. For example, the housing around Medicine Lake has not altered the uses of the waters of Medicine Lake for spiritual quest, although access has diminished.

Tangibility and Definition of the Property: Traditional cultural properties must be tangible places, and therefore must have some kind of boundaries. The entire Medicine Lake Highlands and Timber Mountain areas are each considered to be a single cultural property by native consultants; therefore these "sub-areas" are not viewed by the native communities in the area as specific sites but as integrated parts of a whole landscape.

In the context of Section 106, traditional cultural properties continue to be thought of in the same way as archaeological sites or historic buildings. Traditional cultural properties must be identified, evaluated, and treated during the Section 106 compliance process along with archaeological and historic properties. To do so requires that traditional cultural properties be neatly bounded places. This emphasis is for dealing with particular places on the landscape rather than the landscape itself. The tribal interviews resulted in the identification of many specific sites important to local tribal members; these specific sites could be considered to be traditional cultural properties. However, the artificial isolation of places of significance from the whole landscape of which they are an integral part often conflicts with the cultural principles that make certain places culturally significant to begin with. In the case of the Medicine Lake Highlands area, perceived as a whole culturally by local tribes, the cultural entity coincides with the geologic area referred to as an easterly projection of the Cascade Range into the Modoc Plateau. This culturally/geologically connected highland area, made up of a variety of important topographical features (e.g., springs, caves, lava flows, mountains), continues to hold cultural and spiritual significance to present-day local native peoples. The Timber Mountain area forms a segment of the Modoc Plateau, culturally integrated with the Dry Lake Beds which contain many activity sites, as well as an association with the historically significant Modoc war. Timber Mountain continues to be an area of spiritual significance to Pit River, Klamath, and Modoc peoples, and has on its upper flanks a spiritual site of both historic and contemporary importance to both groups.

TRIBAL CONCERNS

American Indian concerns and questions regarding the proposed project obtained from the tribal consultation meetings, written comments, and the interviews have been summarized and organized by subject below. The topics are presented in the same order in which they are presented in this EIS/EIR.

Geology and Soils

- Underground cave-ins could affect the surrounding environment.

Hydrology

- The impacts the proposed project would have upon the water quality of Medicine Lake is a concern.
- Any potential for effects from pipeline ruptures on habitat and/or surface water and groundwater should be avoided.
- Water quality should be maintained for spiritual and medicinal uses.
- The alteration of thermal springs and any associated health effects upon human users are a concern.

Geothermal

- Data on the frequency of drilling and the location of new drill holes should be provided.
- Data on the purpose and maintenance of injection wells and any impacts associated with them should be provided.
- Protection measures for rupturing of production and injection lines should be addressed.

Cultural Resources

- The route along the proposed transmission line is "rich" with cultural resource sites.
- Concerns that archaeologists used by Calpine not be the same company that was removed from the Sierra Pacific Transmission Line Project.
- Transmission line placement, particularly in the Dry Lakes area and immediately north of Medicine Lake, could affect the spiritual nature of areas and archaeological sites.
- The avoidance of any effects upon archaeological sites from transmission line placement throughout the project area, particularly the Medicine Lake Highlands and Fourmile Hill areas, is needed.
- Tribal members are concerned about any effects on the entire Medicine Lake area and its spiritual values.

Traditional Cultural Values

- Geothermal operations would affect American Indians when they practice their spiritual activities in the Medicine Lake Highlands.
- The geothermal plant could alter the characteristics of the area to such a degree that the American Indians might choose not to use the area spiritually.
- Compensation or mitigation for American Indians' inability to practice spiritual activities in the area is needed.
- This geothermal activity is an attack on American Indians' first amendment rights (i.e., the freedom of religion). The activity will preclude the local tribes from practicing their religious activities in the Medicine Lake Highlands.
- American Indians have no fixed time that they use the area to practice their religious activities. Thus it would be difficult to "schedule" geothermal activities around spiritual practices.
- The Federal government is allowing economic development while sacrificing American Indian values of the area.
- The area proposed for development is one of great cultural significance to American Indians. This area is located in aboriginal land and has ceremonial values.
- American Indian cultural and spiritual rights need to be respected and supported.

- Possible loss or restriction of access to traditional use areas that may be located in the project area is a concern.
- Further restriction of access to traditional/contemporary gathering areas and sites used for spiritual purposes is a concern.
- Loss of access to medicinal plants and traditional resource collecting should be avoided.
- It is important for the Pit River Tribes and Modoc National Forest to establish a MOU.
- Consultation should occur between USFS line officers and Tribal Council officials.
- The project is being pushed ahead without resolution of approval from the Pit River Nation.
- The Chiloquin, Wintun, Tule, Modoc, and Shastan peoples need to be notified of the project.
- Advance copies of all project reports should be sent to local tribes.
- A preservation plan would help treat the Medicine Lake area as a system in future planning, and avoid current isolated project planning practices.
- A "Cultural Management Plan" for the entire Medicine Lake Highlands, which would include the land from Little Glass Mountain to Big Glass Mountain, and from Six Shooter Butte to Mt. Dome, should be developed.
- The geothermal project affects more than the exact site where the geothermal activities are occurring. The activities will change the character of the entire Medicine Lake Highlands.
- The project's potential effects on not only treaty rights land, but all surrounding ceded lands as well, is a concern. Sites located off of the treaty rights lands, such as Medicine Lake and its surrounding areas, continue to be very meaningful to the tribes.

Vegetation

- Loss of vegetation resources in the project area is a concern.
- Impacts to the ecosystem (potential loss of interacting components) and impediments to its ability to function should be avoided.
- Effects to vegetation from project chemicals is a concern.
- Any effects from sulfur seepage on the surrounding habitat should be avoided.

Wildlife

- Ground production and injection wells may impact wildlife and habitat.
- Effects on wildlife from power plant operation should be avoided.
- Plant spraying and other habitat control is a concern.

Visual Resources

- Visual impacts to the area will be significant.
- The operation can and will be seen from all the mountain tops in the area.
- Drilling rigs and the cooling towers seen from various mountain tops and from within the Medicine Lake area will affect visual resources.
- Transmission towers and their visibility from numerous points within the Medicine Lake area will affect visual resources.
- The visual integrity of the area is very important to the local tribes; uninterrupted vistas are critical for their religious practices.
- The natural tranquillity of the area within the Medicine Lake caldera will be affected.
- Any effects upon the Medicine Lake area that would make it less aesthetically pleasing should be avoided.

- The broader effect the project could have on other important topographical features, spiritually (e.g., Mt. Shasta), should be avoided.

Noise

- Noise impacts at thermal expansion areas are a concern.

Transportation

- Plowing of roads during winter months should be addressed.
- Additional road construction should be avoided.

Human Health and Safety

- Geothermal process pollutants/chemicals could harm groundwater, kill plant life, or harm the surrounding environment.

Socioeconomics

- Tribal financial interest in this project and identification of the owner of the geothermal energy should be disclosed.
- Payment of road maintenance crews should be addressed, particularly regarding the plowing of roads during winter months.

Cumulative Impacts

- This project should not be similar to projects in the Shasta area, where the Federal government examined effects on the region project by project (i.e., in a segmented manner) rather than determining all projects' effects on the entire Shasta area.
- The entire Medicine Lake area is considered sacred and the cumulative effects for the whole region should be addressed.
- The potential for expanded future development is a concern.

During the consultation process, land use issues that are not related to the proposed project were expressed by tribal members. Concerns that range beyond project-specific issues and are related to USFS management practices would need to be addressed in documents and USFS planning processes separate from this EIS/EIR.

TRIBAL RECOMMENDATIONS

The USFS and BLM have ongoing consultations with the local tribes, and are in the process of establishing government-to-government agreements with the tribes. To date, the Pit River Nation has issued a resolution against the project and stated that the project should not proceed without the approval of the Pit River Nation (note: the Pit River Nation does not have legal authority over the proposed project).

The consultations with the Klamath Tribes have been with the tribal staff. The Klamath Tribes Cultural Heritage Committee has issued a statement that they are in strong opposition to the project. The Executive Council has not yet issued a decision or made recommendations about the proposed project.

American Indians consulted in ethnographic interviews provided recommendations for the current, ongoing government-to-government consultation process and for the proposed project:

EIS/EIR Process

- A cultural resources management plan should be developed.
- The project should be halted until American Indian issues are resolved.

Transmission Line

- A buried transmission line should be considered.
- The transmission line should be located far north of Medicine Lake.
- The transmission line should avoid the Dry Lake area.

Use Permits

- General policy (rather than specific use permits) should be instituted that would allow local tribes to use the area for traditional practices, such as hunting, gathering, and spiritual purposes.

Tribal Participation

- Developers should take advantage of trained tribal survey/cultural resource personnel who have expertise on the local tribes and the geographical area.
- Active participation of the local tribes with appropriate government agencies and private developers in the protection and preservation of the area, in order to assure American Indian rights, should be encouraged.
- Local tribes should work with developers and appropriate government agencies to contribute to the decision making process.

Cumulative Impacts

- The cumulative effects of projects in the area should be addressed.

3.7 Vegetation

STUDY AREA

The study area for the project and alternatives includes the proposed wellfield and power plant area, the freshwater pipeline, and the transmission line routes. The wellfield and power plant area consists of approximately 640 acres. All production and injection wellpads, associated pipelines and access roads are included in the study area, as well as most of Section 28, T43N R3E, MDB&M, and adjacent portions of the southeast quarters of Sections 21 and 29. The freshwater pipeline study corridor is a 50-foot wide and runs approximately 4.9 miles southeastward from the proposed power plant location to Arnica Sink. The proposed alternate transmission line study areas consist of a 1,000-foot wide corridor centered on the proposed and alternate alignments, each extending for approximately 24 miles from the proposed power plant to the proposed substation or alternate along the BPA Malin-Warner line. The western portion of the study area is located within the Medicine Lake Highlands, while the eastern portion is located within the Modoc Plateau. The Medicine Lake Highlands turns into the Modoc Plateau at approximately the boundary between Siskiyou and Modoc Counties (moving west to east).

METHODOLOGY

This section of the EIR/EIS was prepared by reviewing existing published and unpublished reports on the region and the proposed project area, including reports on floristic-level inventories and habitat assessment-level surveys conducted in connection with this project (BioSystems 1996, Figura 1995, Leitner 1996, and Renner 1995). Published references include the California Natural Diversity Data Base (CNDDB) (CDFG 1996a), the California Native Plant Society's (CNPS) *Inventory of Rare and Endangered Vascular Plants* (Skinner and Pavlik 1994), and the Klamath and Modoc National Forest lists of sensitive and special interest plants (Sanger 1996, pers. com.; Williams 1996, pers. com.).

Based on this information, a list of potentially-occurring special-status plants was prepared for the study area. Plant taxa were considered to be special-status species if they were classified as one or more of the following:

- Listed, or proposed for listing, as Threatened, Endangered, or Species of Concern (formerly listed as Candidate List 1 or 2) under the Endangered Species Act by the U.S. Fish and Wildlife Service (CDFG 1996a and 1996b)
- Listed, or proposed for listing, as Rare, Threatened, or Endangered under the California Endangered Species Act (CDFG 1996b)
- Listed as "Sensitive" or "Special Interest" by the USFS (Sanger 1996, pers. com., Williams 1996, pers. com.)
- Listed as "Survey and Manage," Category 2, in the Northwest Forest Plan (USFS 1996)
- Listed as Category 1, 2 , 3, or 4 of the CNPS *Inventory of Rare and Endangered Vascular Plants of California* (Skinner and Pavlik 1994)
- Meet criteria for listing under the California Environmental Quality Act (CEQA Guidelines, Section 15380)

Surveys of the wellfield and power plant study area and the transmission line segments were conducted in July and August 1996, and followed CNPS guidelines (Skinner and Pavlik 1994). Surveys determined the likelihood of special-status species in the project area and allowed vegetation communities within the project area to be mapped. Vegetation communities were recorded using U.S. Geologic Survey (USGS) 1:24,000 scale maps, aerial photographs, and Wildlife Habitat Relationships (WHR) vegetation type maps (Mayer and Lauden-Slayer 1988). A modified system of nomenclature based upon Holland 1986, Sawyer and Keeler-Wolf 1995, and USFS timber/vegetation maps was used for vegetation community type classification. Sensitive vegetation communities were determined based on the following criteria:

- Classified as "high priority for inventory" in the CNDDB (CDFG 1996a)
- Appeared to meet the criteria which defines wetlands (including a prevalence of hydrophytes, hydric soils, and wetland hydrology)

REGIONAL OVERVIEW

The Medicine Lake Highlands is a region characterized by both high elevation and high precipitation. The vegetation is a mosaic of upper montane conifer forest types, primarily dominated by California red fir (*Abies magnifica*) and lodgepole pine (*Pinus contorta* var. *murrayana*). The forests are intermixed with barren, non-forested areas associated with recent volcanic activity such as rock outcrops, lava flows, and pumice deposits. As the elevation in the area decreases, the upper montane coniferous forest types change into lower montane coniferous forests dominated by ponderosa pine (*Pinus ponderosa*) and white fir (*Abies concolor*). At the lower elevations present within the Modoc Plateau, the ponderosa pine forest becomes sparse, and eventually gives way to shrub-dominated systems and sparse western juniper woodlands.

Vegetation Community Types

Sixteen vegetation community types were mapped in the project area (see Table 3.7-1). Appendix C provides a detailed description of each community type, and identifies the plant species typically found in each vegetation community.

Table 3.7-1: Vegetation Community Types in the Project Region

Lodgepole pine forest	Ponderosa pine forest
Red fir forest	Ponderosa pine plantation
Upper montane mixed conifer forest	Northern juniper woodland
Meadow	Sagebrush scrub
Montane chaparral	Rabbitbrush scrub
Rock outcrops	Vernal marsh/stockpond
Herbaceous	Disturbed
Lower montane mixed conifer forest	Agriculture/planted

SOURCE: Leitner 1997

Special-Status Plant Species

A number of special-status plant species occur or have the potential to occur in the project area (see Table 3.7-2). Additional information on special-status species, such as habitat needs and flowering periods, is provided in Table C-1 of Appendix C. Table C-1 also identifies special-status plant species that were determined to have extremely limited or no potential habitat in the project area.

Special-Status Lichen and Fungi: Two special-status species of fungi occur or may occur within the project area. The systematic survey of fungi is very difficult because fungi are observable briefly and irregularly depending on climatic conditions. The false truffle (*Nivatogastrium nubigenum)* and the false morel (*Gyromitra gigas*) are USFS Survey and Manage species that may occur in the project area. Other lichen and fungus species listed in the Northwest Forest Plan (USFS and BLM 1994) may occur in the late seral forests in the study area. Survey protocols have not yet been developed for these species, and some time will be required for the USFS to fully assess their status in this area.

Judy Harpel, the USFS survey and manage coordinator for bryophytes and lichens for the Northwest Forest Plan, visited the Medicine Lake Highlands in September, 1997. During her visit, she ascertained the potential occurrence of survey and manage bryophytes and lichens in the region. Ms. Harpel found no evidence of suitable habitat for any of the USFS survey and manage bryophytes and lichens in the Medicine Lake Highlands. Furthermore, Ms. Harpel doubted that suitable habitat would be found at lower elevations on the east side of the Medicine Lake Highlands, towards the Modoc Plateau. These conclusions are documented in a letter by Allison Sanger, Modoc National Forest botanist, dated October 6, 1997.

False truffle: The false truffle inhabits coarse, woody material in late-seral forests at mid- to high elevations. Potential habitat for the False truffle is found in red fir forest. It is usually observed in brief periods during the fall, and it has been observed in the vicinity of the wellfield and power plant area (Stout 1996, pers. com,).

False morel: The false morel prefers late seral forest stands and deep duff, however little information is available on its exact range and habitat requirements. It would not likely be found in the project vicinity.

PROPOSED ACTION (ALTERNATIVE 1)

The proposed wellfield and power plant area and the western portion of the proposed transmission line route is located in high elevation coniferous forest. The central and eastern portions of the transmission line route move through increasingly lower elevations until the Modoc Plateau is reached, where shrub-dominated habitats exist. Figures 3.7-1, 3.7-2, 3.7-3, and 3.7-4 illustrate the distribution of vegetation community types in the wellfield and power plant area and along the proposed transmission line route. Any special-status plant species located in these areas are also identified in the figures provided. The existing environment for vegetation at the wellfield and power

Table 3.7-2: Special-Status Plant Species Known to Occur or with the Potential to Occur in the Project Area. Plants are categorized by broad taxonomic groups. Within these groups, they are listed alphabetically by species.

Species	Federal [1]	State [2]	USFS [3]	CNPS [4]
Ferns and fern allies				
Azolla mexicana (Mexican mosquito fern)	-	-	SI	4
*Botrichium crenulatum** (Scalloped moonwort)	SC	-	SI	1B
Marsilea oligospora (Nelson's pepperwort)	-	-	SI	3
Conifers				
Cupressus bakeri (Baker's cypress)	-	-	SI	4
Dicots				
*Allotropa virgata*** (Sugar stick)	-	-	SM	-
*Antennaria flagellaris** (Stoloniferous pussytoes)	-	-	S	4
Arabis microphylla var. *Microphylla* (Small-leaved rock cress)	-	-	SI	4
Arabis oregana (Oregon rock cress)	C3c	-	SI	4
Arnica fulgens (Hillside arnica)	-	-	SI	2
Arnica sororia (Twin arnica)	-	-	SI	2
Astragalus inversus (Susanville milk-vetch)	-	-	SI	4
Camissonia minor (Nelson's evening-primrose)	-	-	SI	4
Campanula scabrella (Rough harebell)	-	-	SI	4
Chenopodium simplex (Large-seeded goosefoot)	-	-	SI	4
*Claytonia umbellata** (Great Basin claytonia)	-	-	SI	1B
*Collomia larsenii** (Tallus collomia)	C3c	-	S	2
Delphinium stachydeum (Spiked larkspur)	-	-	SI	4
Dimeresia howellii (Doublet)	-	-	SI	4

Table 3.7-2: Special-Status Plant Species Known to Occur or with the Potential to Occur in the Project Area (continued)

Species	Federal [1]	State [2]	USFS [3]	CNPS [4]
*Erigeron elegantulus*** (Volcanic daisy)	-	-	SI	4
Erigeron inornatus var. *Calidipetris** (Hot rock daisy)	-	-	SI	4
*Eriogonum prociduum** (Prostrate buckwheat)	-	-	S	1B
Gentiana affinis var. *Parvidentata* (Small-toothed prairie gentian)	-	-	SI	3
Gratiola heterosepala (Boggs Lake hedge-hyssop)	C3c	CE	S	1B
Hackelia cusicki (Cusick's stickseed)	-	-	S1	4
Iliamna bakeri (Baker's globe mallow)	-	-	SI	4
*Ivesia paniculata** (Ash creek ivesia)	SC	-	S	1B
Lomatium peckianum (Peck's lomatium)	C3c	-	-	2
Lupinus aridus ssp. *Ashlandensis* (Mt. Ashland lupine)	-	CA	-	-
Mimulus pygmaeus (Egg Lake monkeyflower)	SC	-	S	1B
Navarretia subuligera (Awl-leaved navarretia)	-	-	SI	4
*Penstemon cinereus*** (Gray penstemon)	-	-	SI	4
Penstemon cinicola (Ash beardtongue)	C3c	-	SI	4
*Penstemon heterodoxus** (Shasta beardtongue)	-	-	SI	4
Phacelia cookei (Cooke's phacelia)	SC	-	-	1B
*Phacelia inundata*** (Playa phacelia)	-	-	SI	2
Pityopus californicus (California pinefoot)	C3c	-	SI	4
Pogogyne floribunda (Profuse-flowered pogogyne)	-	-	SI	1B
Polygonum polygaloides ssp. *Otericum* (Modoc County knotweed)	-	-	S	1B
*Potentilla newberryi*** (Newberry's cinquefoil)	-	-	SI	2

Table 3.7-2: Special-Status Plant Species Known to Occur or with the Potential to Occur in the Project Area (continued)

Species	Federal [1]	State [2]	USFS [3]	CNPS [4]
Psilocarphus elatior (Tall woolly marbles)	-	-	SI	4
Rorippa columbiae (Columbia yellow cress)	SC	-	S	1B
Salix bebbiana (Gray willow)	-	-	SI	2
Salvia dorrii var. *Incana** (Fleshy sage)	-	-	SI	3
Tauschia howellii (Howell's tauschia)	SC	-	-	1B
Thermopsis californica var. *Argentata* (Silvery false-lupine)	-	-	SI	4
Trimorpha acris var. *Debilis* (Northern daisy)				
Monocots				
Calochortus greenei (Greene's mariposa lily)	SC	-	SI	1B
Calochortus longebarbatus var. *Longebarbatus* (Long-haired star tulip)	SC	-	-S	1B
*Carex geyeri** (Geyer's sedge)	-	-	SI	4
*Carex halliana*** (Hall's sedge)	-	-	SI	2
Carex petaseta (Liddon's sedge)	-	-	SI	2
Cypripedium montanum (Mountain lady's slipper)	C3c	-	SM	4
Trillium ovatum ssp. *Oettingeri* (Salmon Mts. wakerobin)	C3c	-	-	4

Notes:

[1] Federal: SC-Species of Concern (formerly Candidate Lists 1 and 2): C3c-Candidate List 3, not a candidate because too widespread and/or not threatened

[2] State: CE-Endangered; CA-Candidate for listing

[3] USFS: S-sensitive (on either the Modoc or Klamath National Forest; SI-Modoc National Forest special interest plants; SM-survey and manage, Category 2, Northwest Forest Plan

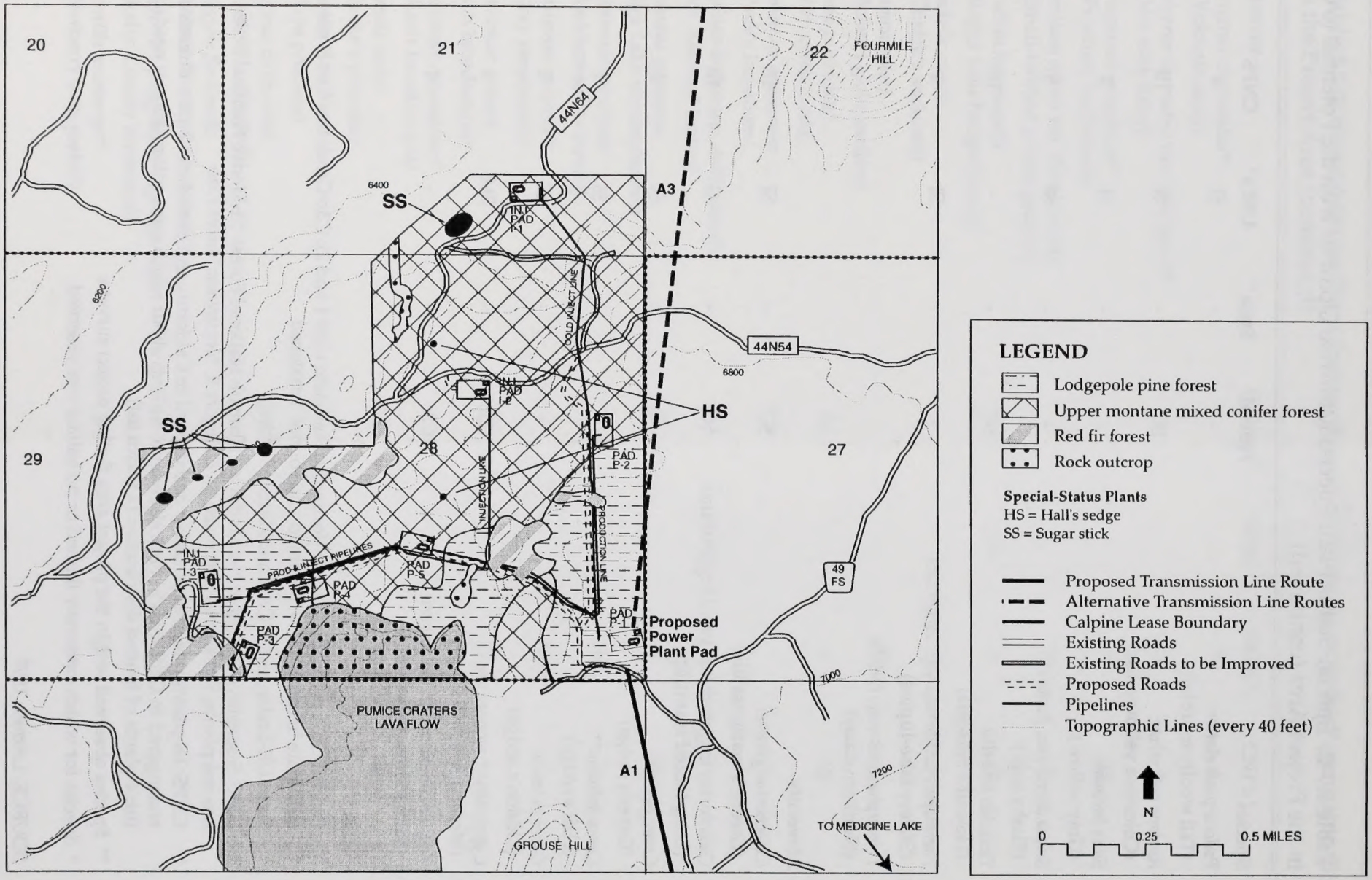
[4] CNPS: 1B-plants rare, threatened or endangered in California and elsewhere; 2-rare, threatened or endangered in California but not elsewhere; 3-plants about which more information is needed, a review list; 4-plants of limited distribution (a watch list)

** Species observed within the project area during project surveys

* Species for which extremely limited or no habitat was observed

SOURCE: Leitner, 1997

Figure 3.7-1: Vegetation Resources at the Power Plant and Wellfield Area



MHA *Environmental Consulting, Inc.*

SOURCE: Calpine

Figure 3.7-2: Vegetation Resources Along Proposed Transmission Line Segments A1 and A2

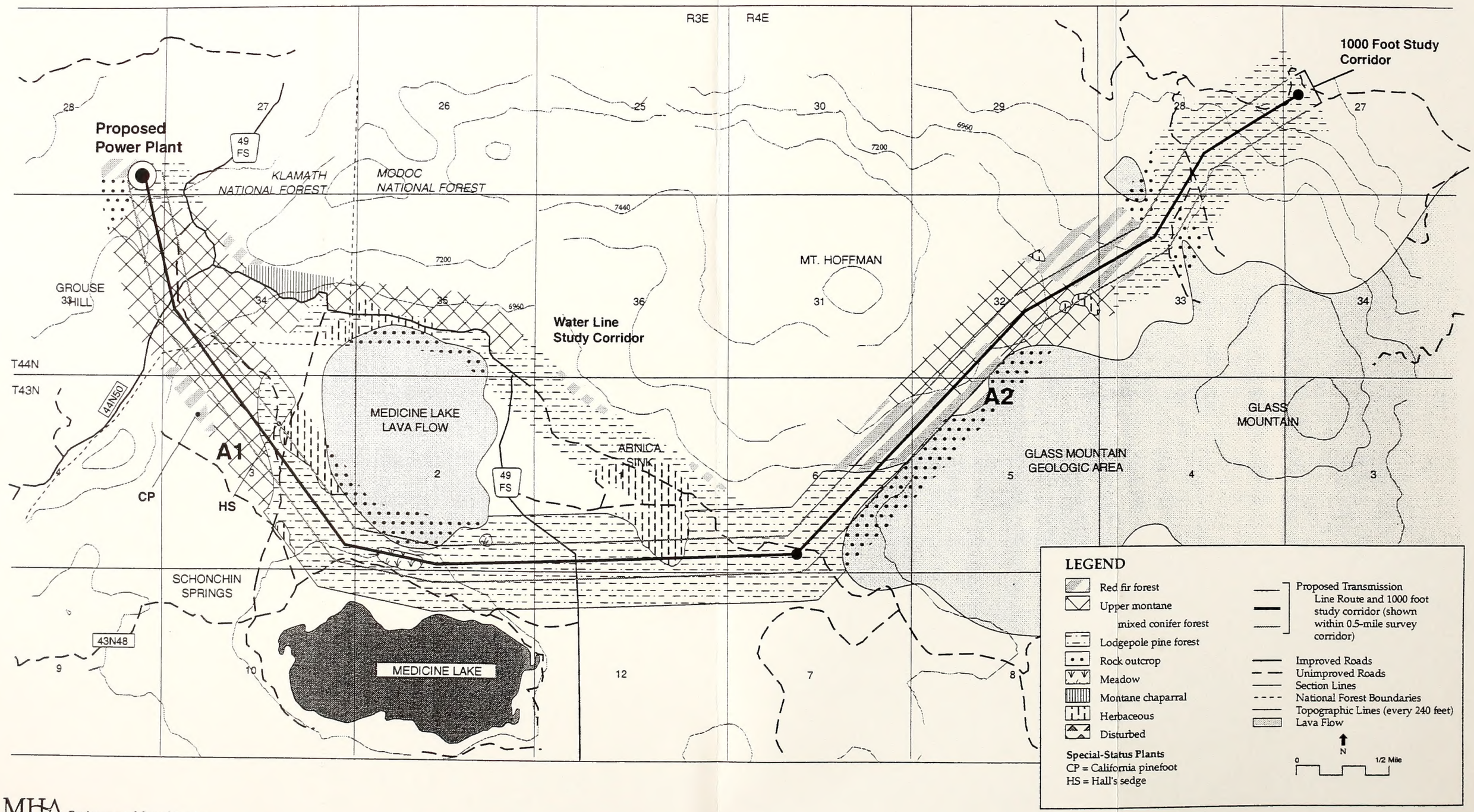
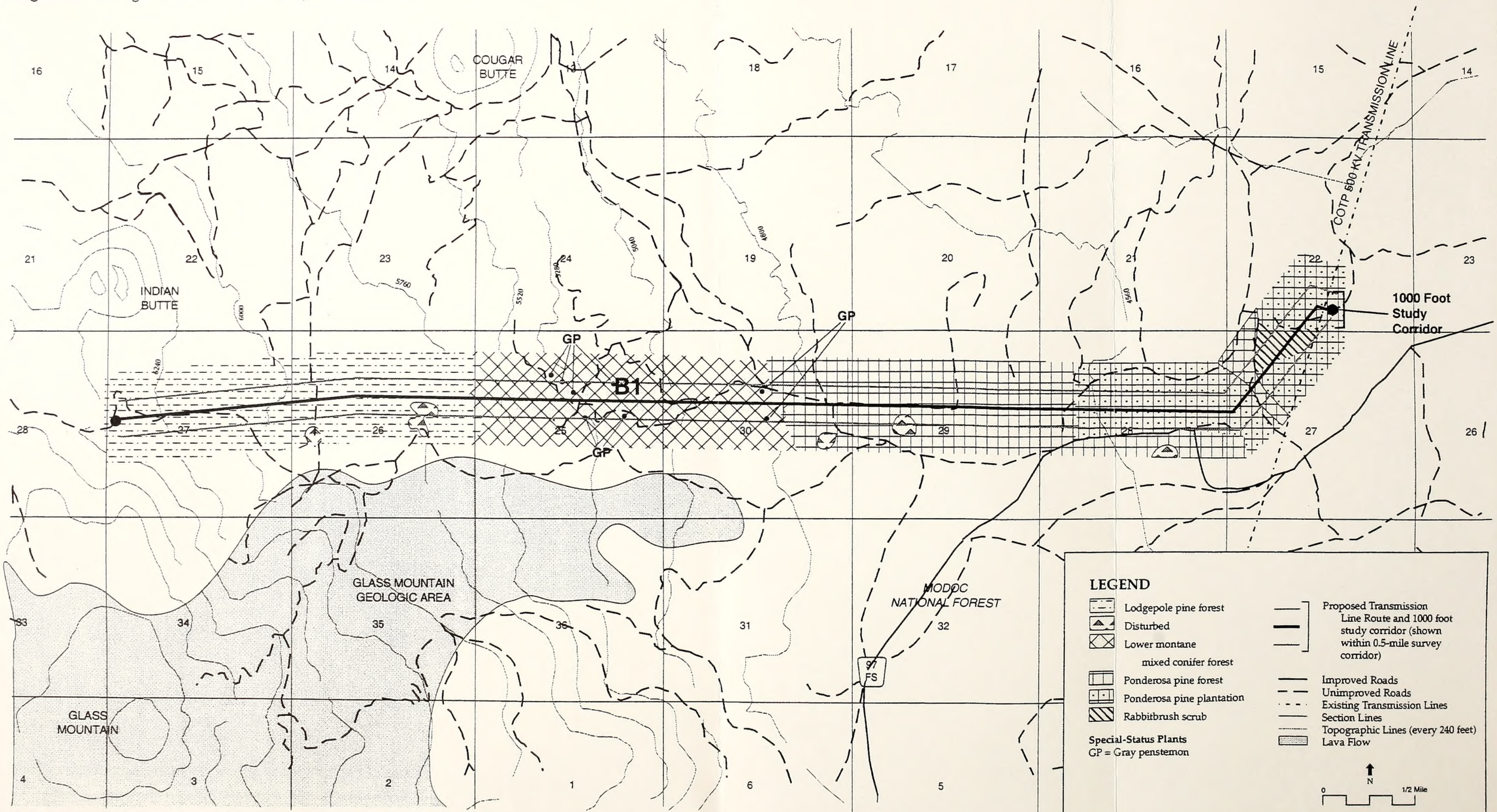




Figure 3.7-3: Vegetation Resources Along Proposed Transmission Line Route B1



plant area, freshwater pipeline, and transmission line route are discussed in more detail below, according to:

- Vegetation community types
- Special-status species
- Sensitive communities

Wellfield and Power Plant Area

Vegetation Community Types: The wellfield and power plant area is vegetated primarily with upper montane mixed conifer forest that has been selectively logged (see Figure 3.7-1). The other vegetation community types found in this area are:

- Lodgepole pine forest
- Red fir forest
- Rock outcrops

Lodgepole pine forest is found in the level and gently sloping parts of the wellfield and power plant area, mainly in the southern half where the proposed power plant site is located. Red fir forest is located in a group of small stands in the east-central part of the wellfield and power plant area on steep slopes, and in a large stand in the west-central part of the wellfield and power plant area. This large stand of red fir forest extends to the north and west of the study area. Rock outcrops were mapped primarily in the southern portion of the wellfield and power plant area. The largest rock outcrop is a recent lava flow, sparsely vegetated and consisting of very rough, unweathered rock.

Special-Status Species: Two special-status plants were identified in the wellfield and power plant area during project surveys. A single, small population of Hall's sedge (*Carex halliana*) was observed in an open area of sparse lodgepole pine in the central part of the wellfield area. Hall's sedge is on the CNPS List 2 and has been designated as a Modoc National Forest Special Interest species. Sugar stick (*Allotropa virgata)* was observed in the wellfield and the power plant area as single individuals in fewer than five sites in densely forested, shady sites with accumulations of downed wood. Sugar stick is listed as an USFS Survey and Manage species. The false truffle, a USFS Survey and Manage species, and California pinefoot *(Pityopus californicus)* a CNPS List 4 species have potential habitat in the wellfield and power plant area. Table 3.7-3 indicates the special-status plant species that occur or have the potential to occur in, or along proposed action facilities.

Sensitive Communities: No sensitive plant communities were found within the wellfield and power plant study area.

Freshwater Pipeline

Vegetation Community Types: The proposed freshwater pipeline closely follows existing paved and unpaved roads from the wellfield and power plant site to Arnica Sink. It passes through primarily the lodgepole pine and upper montane mixed conifer forest community types. These vegetation community types are the two most common forest types found in this part of the Medicine Lake Highlands. The freshwater pipeline route also passes also through an extensive area of montane chaparral, a vegetation type

Table 3.7-3: Special Status Plant Species in the Vicinity of the Proposed Action

Species	Observed	Potential Habitat
Ash beardtongue	-	A1, A2
Ash penstemon	-	A1
Baker's globe mallow	-	C1
California pinefoot	-	wf/pp[1]
Gray penstemon	B1, C1	-
Hall's sedge	wf/pp	-
Liddon's sedge	-	A1, A2
Sugar stick	wf/pp	A2
Tall woolly marbles	-	C1
Volcanic daisy	C1	-

[1] wf/pp: wellfield and power plant area

SOURCE: LEITNER 1996

dominated by greenleaf manzanita *(Arctostaphylos patula)* and snowbrush (*Ceanothus velutinus*).

Special-Status Species: Based on 1995 botanical surveys, no special-status plants or potential habitat for special-status plants are located along the proposed freshwater pipeline route (Renner 1995).

Sensitive Communities: No sensitive plant communities were found along the proposed freshwater pipeline route.

Transmission Line Route

The proposed transmission line route is composed of segments A1, A2, B1 and C1. The vegetative setting of each segment is discussed below.

Vegetative Community Types: Segment A1 has an elevational range from approximately 6,500 feet to 7,000 feet. From the proposed power plant site to Medicine Lake, the corridor descends through lodgepole pine forest and selectively logged upper montane mixed conifer forest. As the corridor passes through the low areas from Medicine Lake through Arnica Sink, nearly all vegetation is lodgepole pine forest. Segment A1 crosses a meadow that is overtopped by lodgepole pine forest (see the discussion of sensitive communities for the transmission line route for more information on this meadow). Areas dominated by herbaceous vegetation are located within the segment A1 corridor near Arnica Sink (see Figure 3.7-2).

Segment A2 begins at the eastern side of Arnica Sink in lodgepole pine forest, which is replaced by late seral stage red fir as the segment crosses the lower slopes of Mt.

Hoffman. The route then passes into a broad plateau east of Mt. Hoffman that supports upper montane mixed conifer forest. The corridor passes over a low pumice ridge, then drops into a north-facing basin with late seral stage red fir and lodgepole pine forest. Lodgepole pine forest habitat continues to the matchpoint with segment B1 (see Figure 3.7-2).

Segment B1 begins just east of the gravel pit at the northwestern corner of Glass Mountain, at an elevation of about 6,600 feet in lodgepole pine forest. This segment runs easterly, descending to an elevation of about 4,400 feet. The westernmost third of the segment is vegetated with moderately disturbed lodgepole pine forest. The middle third of this segment is primarily lower montane coniferous forest. As the route descends further to the east, natural ponderosa pine forest is replaced by ponderosa pine plantation (see Figure 3.7-3).

The westernmost two-thirds of Segment C1 passes through a mosaic of ponderosa pine plantation, rabbitbrush scrub, and sagebrush scrub. The vegetation community along the remainder of this segment is primarily northern juniper woodland. Human activities, particularly logging and fire, have altered what once was ponderosa pine savanna and is now shrub-dominated. The substation for this segment is located just east of Highway 139, in northern juniper woodland (see Figure 3.7-4).

Special-Status Species: Potential habitat exists along segment A1 for ash beardtongue *(Penstemon cinicola)* and Liddon's sedge *(Carex petaseta)*. No special-status plants were observed on segment A2. Potential habitat for ash beardtongue, Liddon's sedge, and sugar stick exists along Segment A2.

A population of gray penstemon (*Penstemon cinereus*) was observed along segment B1 in gravelly, volcanic soils at low elevations in montane mixed conifer forest. Gray penstemon is a CNPS List 4 plant and a Modoc National Forest Special Interest Species. No other special-status species were identified or are known to occur along segment B1.

Gray penstemon and volcanic daisy (*Erigeron elegantulus*) were both identified along segment C1. Gray penstemon was found in gravelly volcanic soils approximately 0.5 miles northwest of Tionesta (within Section 16). Additional populations were also located approximately 2 miles northwest of Tionesta (within Section 18). Volcanic daisy was found in sagebrush scrub and juniper woodland near the gray penstemon populations. Volcanic daisy is a CNPS List 4 plant and Modoc National Forest Special Interest species. In addition to these species, potential habitat exists along segment C1 for other populations of special-status species, including tall woolly marbles (*Psilocarphus elatior*) and Baker's globe mallow (*Iliamna bakeri*). Tall woolly marbles is generally found in stock ponds and other vernally moist places on the Modoc Plateau, and populations of Baker's globe mallow are commonly found in sagebrush scrub.

Sensitive Communities: Along segment A1, a meadow area was identified that may meet the criteria for wetlands. This meadow is located where Segment A1 passes between Medicine Lake and the Medicine Lake Glass Flow (see Figure 3.7-2). The northern end of the meadow is located about 150 south of the Medicine Lake Glass Flow, and the meadow is approximately 750 feet long (i.e., from west to east) at this location. The meadow is overtopped by lodgepole pines, and the understory is composed of a variety of species adapted to extended periods of high soil moisture,

such as sedges (*Carex* spp.), rushes (*Juncus* spp.), and monkeyflower (*Mimulus*). The meadows present at Medicine Lake are of ecological interest because they have not been grazed by livestock in recent decades (Sanger 1996, pers. com.).

No sensitive plant communities were mapped along segment A2, B1, or C1. However, several dispersed, small, low-lying areas with accumulated soil moisture that may meet wetland criteria exist in sagebrush scrub along segment C1.

ALTERNATIVES

As discussed at the beginning of this chapter, the following describes the affected environment for each alternative to the proposed action. For alternatives 2 through 6, the affected environment for the proposed wellfield and power plant area would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of the existing environment along these portions of the transmission line are not repeated under each alternative discussion. The description of the affected environment focuses on the segments of the transmission line that would be different from those in the proposed action. Tables 3.7-4 and 3.7-5 show the special -status plant species that occur or have the potential to occur in the project area, respectively, according to each alternative. Figures 3.7-5, 3.7-6, 3.7-7, and 3.7-8 show the vegetation community types along the transmission line segments not included in the proposed action.

Table 3.7-4: Special-Status Plant Species Observed in the Project Area

	Alternatives					
Species	**1**	**2**	**3**	**4**	**5**	**6**
	Proposed Action					
Gray penstemon	B1, C1	B1	C1	-	B1, C1	B1
Hall's sedge	wf/pp[1]	wf/pp	wf/pp	wf/pp	wf/pp	wf/pp
Newberry's cinquefoil	-	C2	-	C2	-	C2
Playa phacelia	-	C2	-	C2	-	C2
Sugar stick	wf/pp	wf/pp	wf/pp	wf/pp	wf/pp	wf/pp
Volcanic daisy	C1	-	C1	-	C1	-

[1] wf/pp: wellfield and power plant area

SOURCE: Leitner 1996

Figure 3.7-5: Vegetation Resources Along Alternative Transmission Line Route A3

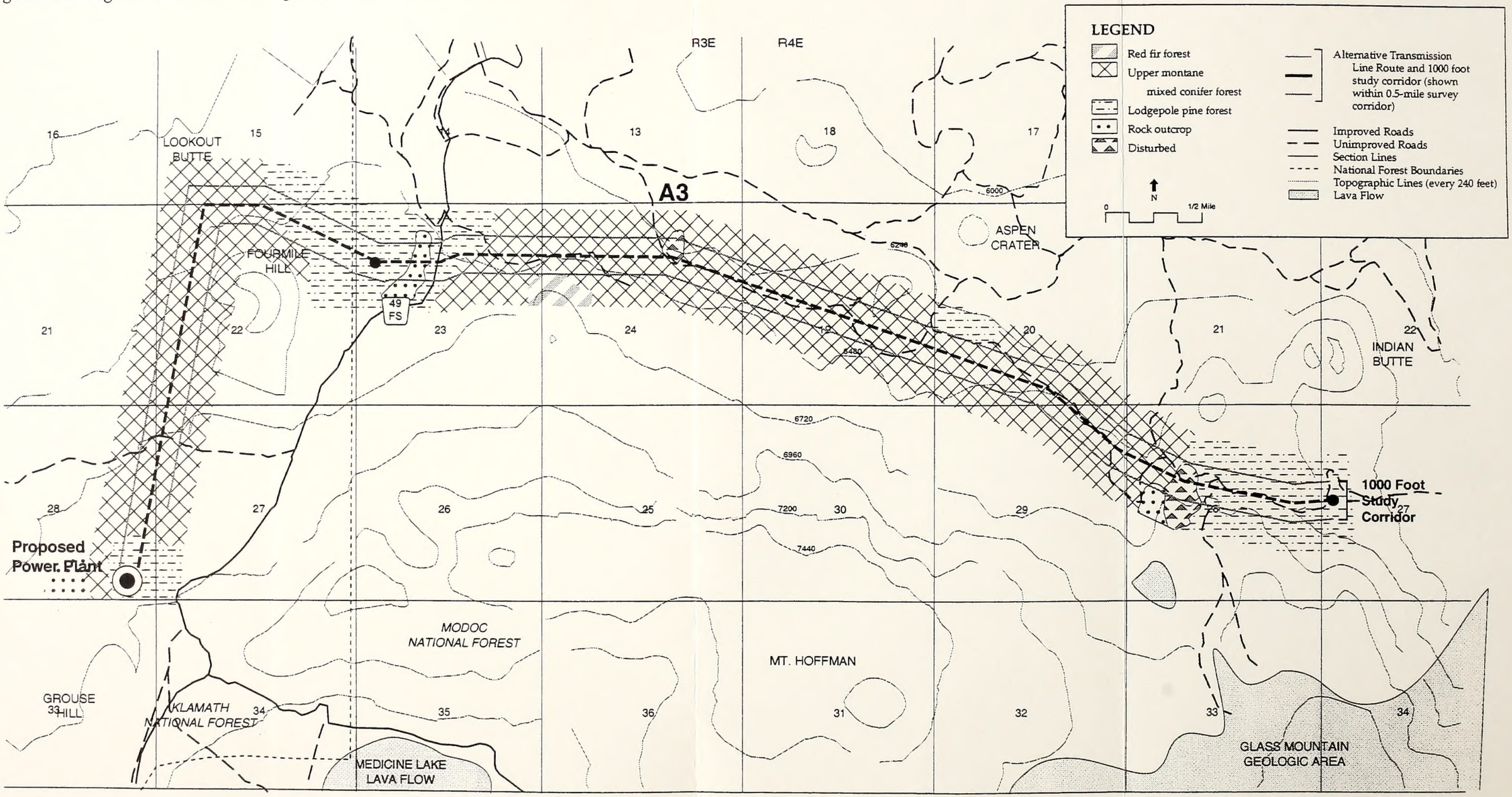


Figure 3.7-6: Vegetation Resources Along Western Portion of Alternative Transmission Line Route Segment B2

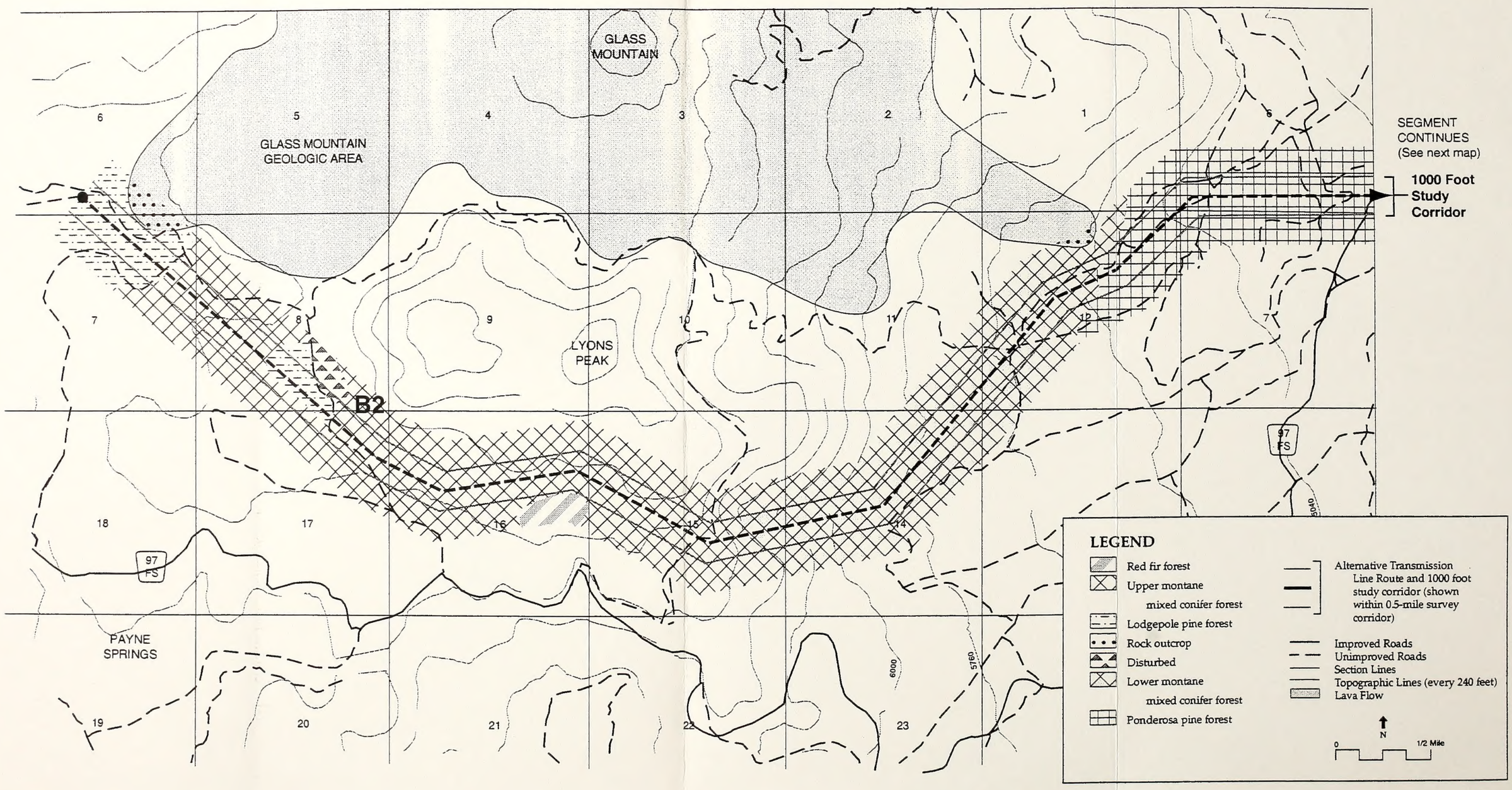


Table 3.7-5: Special-Status Plant Species with Potential Habitat in the Project Area

Species	Alternatives					
	1 Proposed Action	2	3	4	5	6
Ash beardtongue	A1, A2	A1, A2	A1	A1	-	-
Ash penstemon	A1	A1	A1	A1	-	-
Baker's globe mallow	C1	C2	C1, B2	C2, B2	C1	C2
Boggs Lake hedge-hyssop	-	C2	-	C2	-	C2
California pinefoot	A2	A2	B2	B2	A3	A3
Columbia yellow cress	-	C2	-	C2	-	C2
Cusick's stickseed	-	C2	-	C2	-	C2
Egg Lake monkey flower	-	C2	-	C2	-	C2
Gray penstemon	-	C2	B2	B2, C2	-	C2
Hall's sedge	-	-	B2	B2	A3	A3
Hillside arnica	-	C2	-	C2	-	C2
Liddon's sedge	A1, A2	A1, A2	A1	A1	-	-
Mexican mosquito fern	-	C2	-	C2	-	C2
Modoc County knotweed	-	C2	-	C2	-	C2
Nelson's pepperwort	-	C2	-	C2	-	C2
Profuse-flowered pogogyne	-	C2	-	C2	-	C2
Sugar stick	A2	A2	B2	B2	A3	A3
Susanville milk-vetch	-	C2	-	C2	-	C2
Tall woolly marbles	C1	C2	C1, B2	C2, B2	C1	C2
Twin arnica	-	C2	-	C2	-	C2
Volcanic daisy	-	C2	-	C2	-	C2

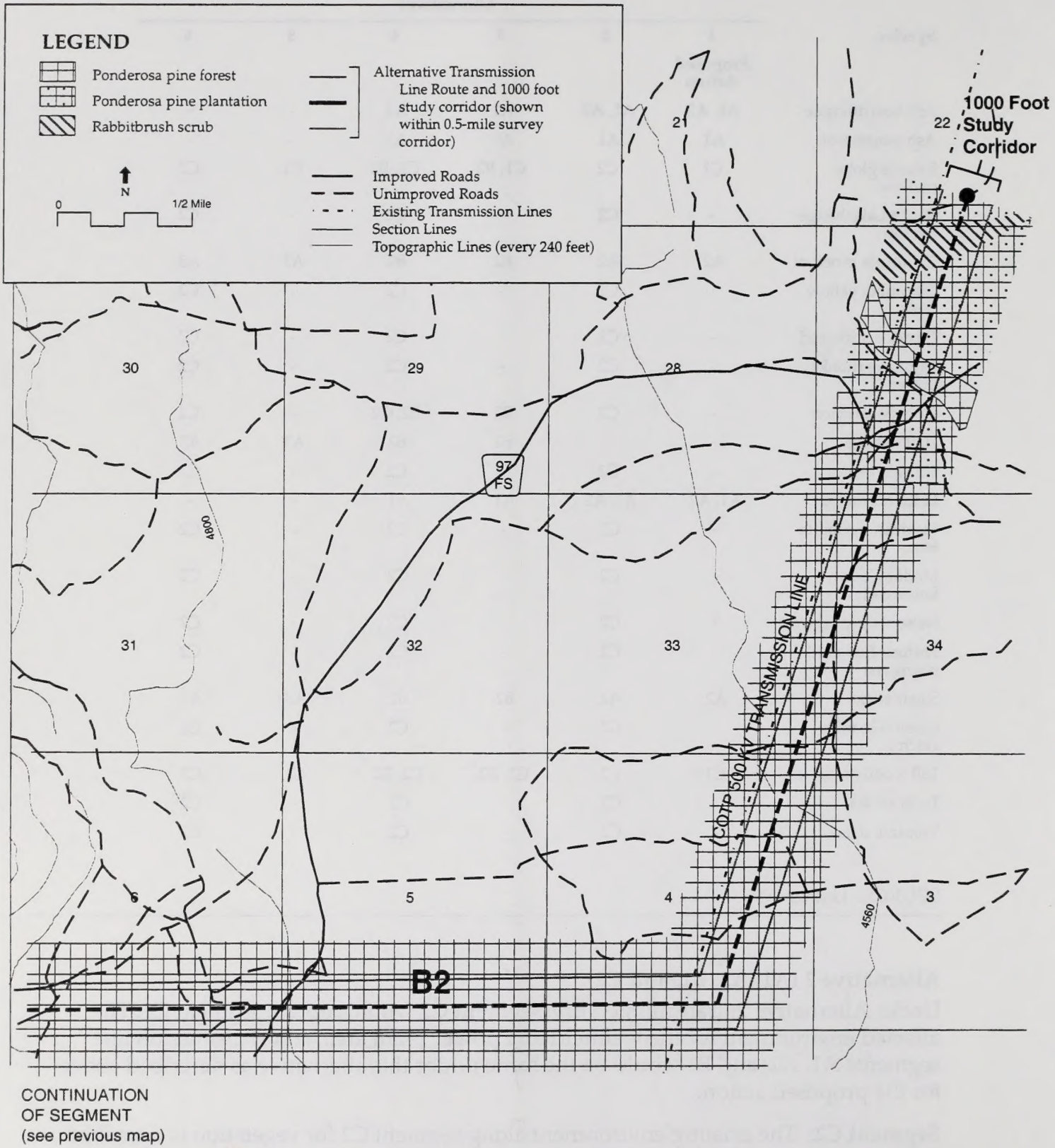
SOURCE: Leitner 1996

Alternative 2 (A1, A2, B1, and C2)

Under Alternative 2, transmission line segment C2 would replace segment C1. The affected environment for the wellfield and power plant area, and transmission line segments A1, A2, and B1 would be the same under this alternative as described above for the proposed action.

Segment C2: The existing environment along segment C2 for vegetation is described below.

Figure 3.7-7: Vegetation Resources Along Eastern Portion of Segment B2



CONTINUATION
OF SEGMENT
(see previous map)

Figure 3.7-8: Vegetation Resources Along Alternative Transmission Line Segment C2

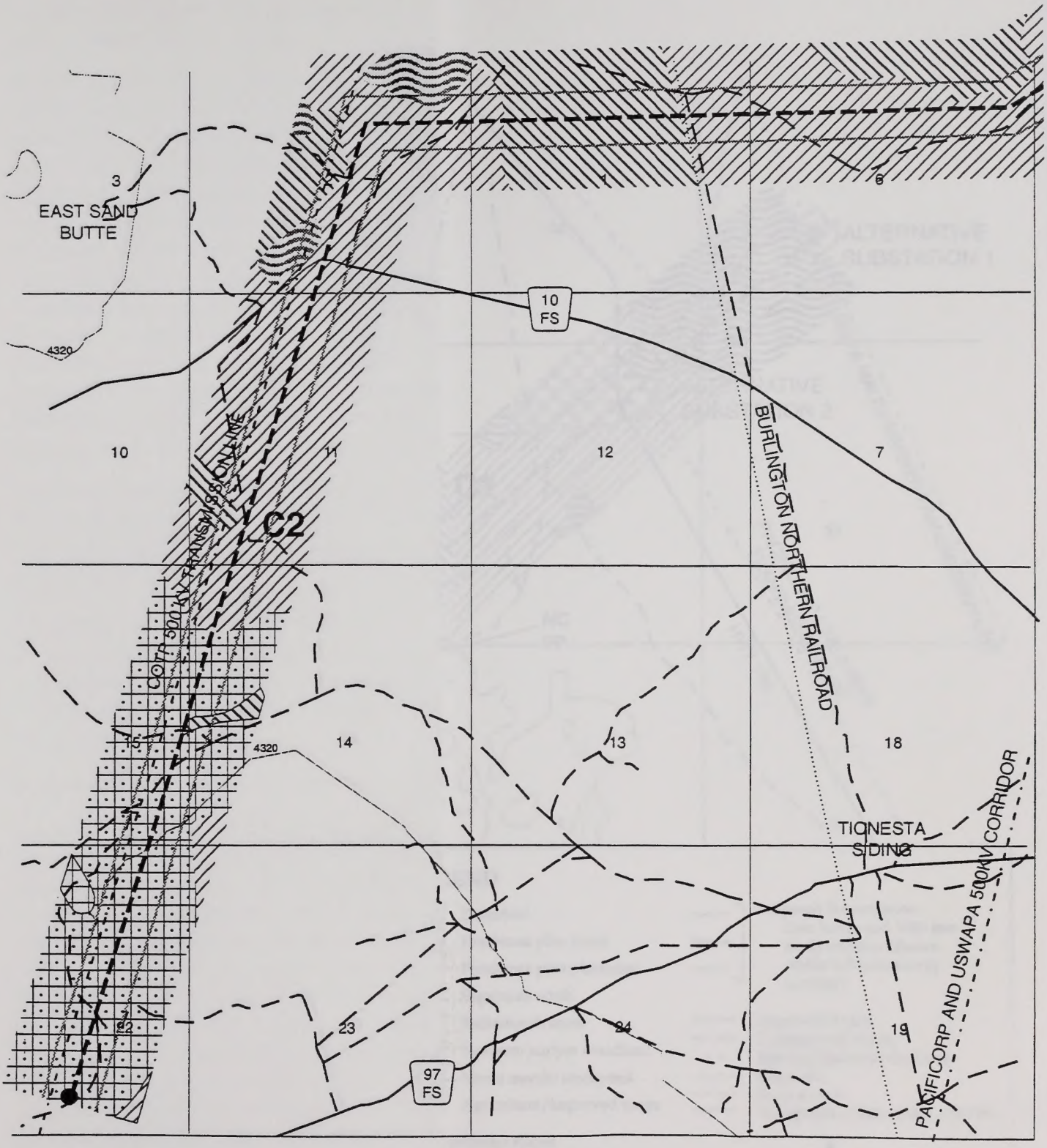
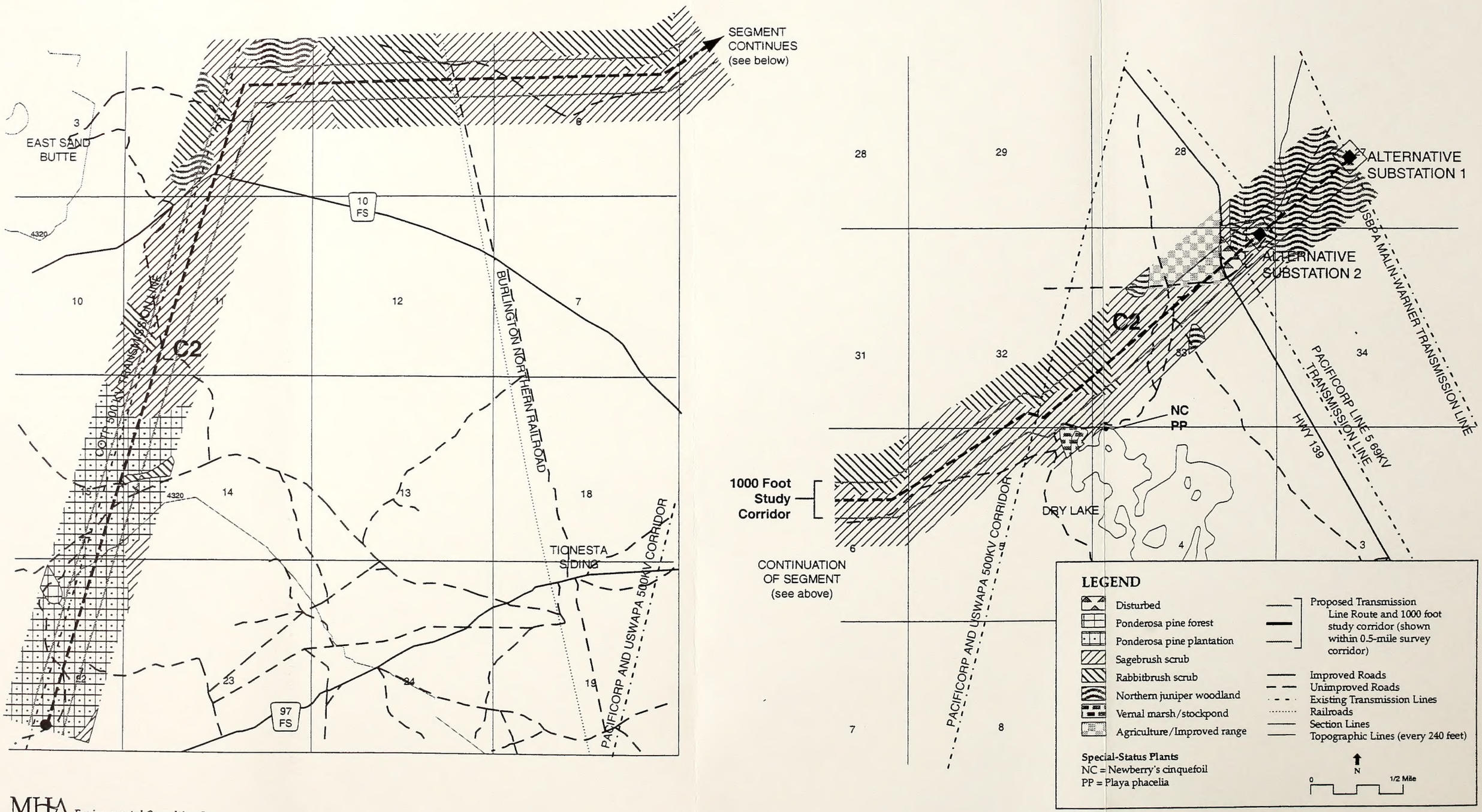


Figure 3.7-8: Vegetation Resources Along Alternative Transmission Line Segment C2





Vegetation Community Types: Segment C2 is vegetated primarily by the shrub communities of sagebrush and rabbitbrush. Logging, and perhaps also fire, has converted open ponderosa pine forest to shrub types in some areas. Northern juniper woodland is present on the eastern portion of this segment. This segment skirts Dry Lake, a large vernal marsh.

Special-Status Species: The segment C2 study corridor includes portions of Dry Lake, where populations of two special-status species, Newberry's cinquefoil (*Potentilla newberryi*) and playa phacelia (*Phacelia inundata*) have been observed. Both of these species are CNPS List 2 plants and Modoc National Forest Special Interest species. Potential habitat for the gray penstemon, Baker's globe mallow, tall woolly marbles, Susanville milk-vetch (*Astragalus inversus*), twin arnica (*Arnica sororia*), Cusick's stickseed *(Hackelia cusickii)* and volcanic daisy exists along segment C2. In addition, potential habitat exists in the vicinity of Dry Lake for several wetland special-status plant species including hillside arnica (*Arnica fulgens*), Mexican mosquito fern (*Azolla mexicana*), Boggs Lake hedge-hyssop (*Gratiola heterosepala*), Nelson's pepperwort (*Marsilea oligospora*), Egg Lake monkeyflower (*Mimulus pygmaeus*), profuse-flowered pogogyne (*Pogogyne floribunda*), Modoc County knotweed (*Polygonum polygaloides ssp. esotericum*), and Columbia yellow cress (*Rorippa columbiae*). Most of these species occur in areas with prolonged soil moisture, which are habitats found near or in Dry Lake.

Sensitive Communities: As stated previously, the study corridor for segment C2 includes the northwestern tip of Dry Lake. This large, seasonal wetland area is considered a sensitive plant community. Small seasonal wetlands may also occur in low-lying areas of segment C2.

Alternative 3 (A1, B2, and C1)

Under Alternative 3, transmission line segment B2 would replace segments A2 and B1. The affected environment for the wellfield and power plant area, and transmission line segments A1 and C1 would be the same under this alternative as described above for the proposed action.

Segment B2: The existing environment along segment B2 is discussed below.

Vegetation Community Types: Segment B2 descends from an elevation of about 6,700 feet at Arnica Sink to about 4,400 feet at its eastern terminus. The vegetation in the western portion, from Arnica Sink to near the crossing of Lyons Mountain Road, is dominated by red fir and lodgepole pine. The centerline of the corridor passes primarily through selectively logged areas where the current dominant species is lodgepole pine. The next four miles descend through upper, then lower montane mixed conifer forest. As white fir, then ponderosa pine become dominant at the lower elevations, red fir and lodgepole pine disappear. From the easternmost toe of Glass Mountain, the remainder of the line passes through vegetation mapped primarily as ponderosa pine forest; most is an open savanna with an herbaceous understory. The final 3 miles, which parallel the California Oregon Transmission Project (COTP) transmission line, consists of open ponderosa pine forest interspersed with shrubland.

Special-Status Species: No special-status plants are known to occur along this segment. Potential habitat exists for sugar stick, California pinefoot, and Hall's sedge in the upper

elevations on the western portion of this segment, and gray penstemon in the mid to low elevations in the eastern portion of this segment. Potential habitat for tall woolly marbles and Baker's globe mallow may be present at the lowest elevations of this segment as it parallels the COTP transmission line. *Sensitive Communities:* Segment B2 crosses the Highhole Managed Late Successional Area (MLSA), which is a lower montane mixed conifer forest with primarily late seral white fir. The segment crosses about a 0.25 mile portion of the MLSA. MLSAs are managed for maximum growth of trees and associated late successional species.

Alternative 4 (A1, B2, and C2)

Under Alternative 4, transmission line segment B2 would replace segments A2 and B1, and segment C2 would replace segment C1. The affected environment for the wellfield and power plant area, and transmission line segment A1 would be the same under this alternative as described above for the proposed action. Existing conditions along segments B2 and C2 are described above under Alternatives 3 and 2, respectively.

Alternative 5 (A3, B1, and C1)

Under Alternative 5, transmission line segment A3 would replace segments A1 and A2. The affected environment for the power plant and wellfield area, and transmission line segments B1 and C1 would be the same under this alternative as described above for the proposed action.

Segment A3: The vegetation community types, special-status species, and sensitive plant communities that exist along segment A3 are discussed below.

Vegetation Community Types: Segment A3 passes through north-facing slopes vegetated with selectively logged upper montane mixed conifer forest until it rounds the northern foot of Fourmile Hill, where it descends into gently sloping area vegetated with lodgepole pine forest. As the segment traverses the north-facing slopes between Mt. Hoffman and Aspen Crater, it passes through upper montane conifer forest, much of it highly disturbed due to logging. The easternmost half-mile of this segment passes into moderately disturbed lodgepole pine forest.

Special-Status Species: No special-status plant species were identified along segment A3, but potential habitat exists for Hall's sedge within dry meadows in lodgepole pine forest and sugar stick and California pinefoot in shady forest stands containing downed wood.

Sensitive Communities: No sensitive plant communities were identified along segment A3.

Alternative 6 (A3, B1, and C2)

Under Alternative 6, transmission line segment A3 would replace segments A1 and A2, and segment C2 would replace segment C1. The affected environment for the wellfield and power plant area, and transmission line segment B1 would be the same under this alternative as described above for the proposed action. Existing conditions along segments A3, and C2 are described above under Alternatives 5 and 2, respectively.

Alternative 7 (No Action)

The setting for Alternative 7, the No Action alternative, would be the same as for the proposed action and the alternatives.

3.8 Wildlife

STUDY AREA

The study area for the project and alternatives includes the proposed wellfield and power plant area, the freshwater pipeline, and the transmission line routes (including proposed and alternative substations). The wellfield and power plant area consists of approximately 640 acres. All production and injection wellpads, associated pipelines and access roads are included in the study area, as well as most of Section 28, T43N R3E, MDB&M, and adjacent portions of the southeast quarters of Sections 21 and 29. The freshwater pipeline study corridor is 50-foot wide and runs approximately 4.9 miles southeastward from the proposed power plant location to Arnica Sink. The transmission line study areas consist of a 1,000-foot wide corridor centered on the proposed and alternate alignments, each extending for approximately 24 miles from the proposed power plant to the proposed substation or alternate along the BPA Malin-Warner line. The western portion of the study area is located within the Medicine Lake Highlands, while the eastern portion is located within the Modoc Plateau. The Medicine Lake Highlands turns into the Modoc Plateau at approximately the boundary between Siskiyou and Modoc counties (moving west to east).

METHODOLOGY

This section of the EIS/EIR was prepared based on field visits and studies, reviewing aerial photography of the project area, experience with geothermal development impacts, and by reviewing available published and unpublished reports on the wildlife resources of the proposed project area. Several reports regarding wildlife resources in the project area have been prepared; these reports are identified in Appendix C. Professional biologists representing government agencies and those who have conducted field studies in the project area were also consulted. In addition, the California Natural Diversity Data Base (CNDDB) records were reviewed for known locations of special-status wildlife species within the 7.5-minute U.S. Geologic Survey quadrangles that cover the project area. A complete list of documents and databases reviewed for this project is contained in Appendix C.

Several surveys for wildlife species have been conducted in the study area and in the surrounding region. The wellfield and power plant area has been surveyed for general wildlife resources and special-status species. A combination of general habitat suitability surveys and surveys for specific species (such as the northern goshawk and northern spotted owl) have been conducted along the proposed transmission line segments, as well as the proposed freshwater pipeline route. These surveys were supplemented with the project-specific biological research described above.

This analysis focuses primarily on special-status species and their habitats. For purposes of this analysis, animal taxa are considered to be "special-status" if they fit one or more of the following categories:

- Listed or proposed for listing as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) under the Federal Endangered Species Act
- Identified as Species of Concern by the USFWS (formerly Candidate List 1 or List 2)

- Listed or proposed for listing as threatened or endangered under the California Endangered Species Act
- Identified as "Species of Special Concern" by the California Department of Fish and Game (CDFG)
- Listed as "Sensitive" by the Regional Forester, Pacific Southwest Region, USFS
- Listed as "Management Indicator Species" by the USFS, Modoc National Forest Land and Resource Management Plan (LRMP)
- Listed as "Species Association" wildlife by the USFS, Klamath National Forest LRMP
- Listed as "Protection Buffer" wildlife in the Northwest Forest Plan
- Currently not listed, but meet criteria for listing in California under the CEQA, State CEQA Guidelines, Sec. 15380

In general, wildlife habitat types within the project area have been classified and described for the analysis of the proposed action in accordance with the CDFG California Wildlife Habitat Relationships System (CWHR). However, two coniferous forest types not included in the CWHR were used to describe habitats that are widespread in the Medicine Lake Highlands portion of the project area:

(1) Upper montane mixed conifer forest is found at higher elevation sites where timber harvest has removed larger-diameter red fir, leaving a mixture of smaller red fir, lodgepole pine, and other conifer species;

(2) Lower montane mixed conifer forest is transitional between higher elevation forest types, characterized by red fir, white fir, and lodgepole pine, and the lower elevation ponderosa pine forest.

A detailed description of each habitat type in the project area is contained in Appendix C.

REGIONAL OVERVIEW

The Fourmile Hill Geothermal Project spans two physiographic regions, the Medicine Lake Highlands and the Modoc Plateau, with quite different wildlife habitats. The Medicine Lake Highlands are dominated by high elevation (4,800 to 8,000 feet) coniferous forests adapted to a deep winter snowpack and a short summer growing season. The Modoc Plateau to the east is lower in elevation (4,000 to 4,800 feet) and has a drier climate, with less winter snowfall and a longer growing season. Wildlife habitats in the Modoc Plateau are much like those typical of the Great Basin, where chiefly shrub/grassland types, sparse juniper woodland, and eastside pine comprise the habitat.

The boundary between the Medicine Lake Highlands and the Modoc Plateau is located approximately between the counties of Siskiyou and Modoc. The Medicine Lake Highlands are located generally in Siskiyou County, and the Modoc Plateau is located in Modoc County (see Figure 2.2-2). The general vicinity of the county line between these two counties serves as a transition area between the Highlands and Plateau regions.

The Medicine Lake Highlands provide habitat for a number of bird and mammal species associated with coniferous forests. However, species richness is reduced relative to many other montane areas in northern California. In spite of the high snowfall in this

area, there is little soil moisture during the summer due to the low water-holding capacity of the loose volcanic soils. As a result, the shrub and herbaceous layers are sparse throughout most of the area. There is little surface water, few permanent streams or riparian habitats, and few springs, meadows, or wetlands. Because of the relative lack of aquatic habitats, amphibian species richness is low. In addition, few reptile species are present because of generally cool temperatures and a short snow-free season. Timber harvest has affected forest habitats throughout most of the Medicine Lake Highlands, so that little undisturbed late successional or mature forest remains. The largest single block of unharvested forest covers much of the upper slopes of Mt. Hoffman. Medicine Lake and smaller lakes to the southeast are important surface waters that provide habitat for birds requiring open water for foraging.

Forest stands in the Medicine Lake Highlands with late successional characteristics, such as high canopy closure and large tree diameter, provide favorable habitat for a number of species of birds and mammals. Special habitat features such as large lava flows, cliffs, caves, rock outcrops, large defective trees, and large snags also are important for many wildlife species.

The Modoc Plateau to the east supports a substantially different assemblage of wildlife species. A narrow zone of ponderosa pine forest extends down from the slopes of the Medicine Lake Highlands and provides habitat for some forest-dependent wildlife species. Extensive timber harvest and fire has impacted much of this zone. Pine plantations and disturbed shrub habitats have replaced much of the open ponderosa pine forest. To the east, most of the project area within the Modoc Plateau is covered by open habitats consisting mainly of sagebrush shrub and juniper woodland with an herbaceous understory of grasses and forbs. Such characteristic Great Basin species as pronghorn and sage grouse are year-round residents, and mule deer from two herds use this area as winter range. There are no permanent streams, riparian corridors, or springs in this part of the plateau, and stock tanks are almost the only source of open water. In the northeastern corner of the project area, a large complex of vernally wet meadows and shallow ponds known as Dry Lake provides wildlife habitat that is used by a variety of species.

PROPOSED ACTION (ALTERNATIVE 1)

General Wildlife Habitats

Wellfield and Power Plant Area: Wildlife habitat within the wellfield and power plant area is generally suitable for bird and mammal species typical of disturbed early to mid-seral higher elevation coniferous forest. Almost all of the area has been selectively logged over the past few decades, so that little late seral forest remains. Some mature trees and large snags are scattered through harvested areas, but canopy closure is relatively low and small trees dominate most stands.

Several forest types provide wildlife habitat in the wellfield and power plant area. These forest types include predominantly lodgepole pine forest and upper montane mixed conifer forest, but a few areas of red fir forest also exist (see Figure 3.7-1). The most notable habitat located in the wellfield and power plant area is two relatively undisturbed red fir stands, which provide some late seral or mature forest habitat for

wildlife species. One of these late successional stands is located in the east-central and the other in the west-central portion of the wellfield and power plant area.

Additional habitats in the wellfield and power plant area include the Grouse Hill Glass Flow (a large lava flow) in the southern portion of the area, and other small areas of rock outcrops scattered throughout the area. This type of habitat may provide appropriate habitat for various special-status bat species in the area. No aquatic or riparian habitats are present within the wellfield and power plant area.

Freshwater Pipeline: Wildlife habitats along the proposed temporary freshwater pipeline are generally suitable for bird and mammal species typical of early to mid-seral upper elevation coniferous forest. Habitats along the pipeline consist of mainly lodgepole pine forest and upper montane mixed conifer forest (see Figure 3.7-2). The pipeline route passes just to the north of the Medicine Lake Glass Flow, an extensive area of a geologically recent lava flow that may provide suitable bat habitat. The south-facing slopes directly northwest of the Medicine Lake Lava Flow support a stand of montane chaparral, which provides some habitat diversity. The route also passes by three stands of red fir forest to the north of the route, as well as herbaceous areas near the Medicine Lake Lava Flow and Arnica Sink.

Proposed Transmission Line: Wildlife habitats along the proposed transmission line route vary according to each transmission line segment. Wildlife habitat along segment A1 is generally suitable for bird and mammal species typical of disturbed early to mid-seral higher elevation coniferous forest. Notable habitat features along segment A1 include a small red fir stand that includes some large trees near Forest Road 44N50, and the small meadow overtopped by lodgepole pine that is located between Medicine Lake and the Medicine Lake Glass Flow (see Figure 3.7-2). Segment A1 also passes directly south of the Medicine Lake Lava Flow, which may provide suitable bat habitat. The dominant wildlife habitats on segment A1 are lodgepole pine forest and upper montane mixed conifer forest. Much of the forested habitat along segment A1 has been selectively logged, which adversely affects the quality of habitat along this segment. Developed recreational uses also occur at Medicine Lake and along roads in this area.

Wildlife habitat along segment A2 is generally suitable for bird and mammal species typical of higher elevation coniferous forest. Two large stands of late seral red fir forest along segment A2 may provide habitat for wildlife species that require higher canopy cover, larger trees, snags, or more abundant downed wood (see Figure 3.7-2). The dominant wildlife habitats along this segment are lodgepole pine forest and upper montane mixed conifer forest. Recent lava flows from Glass Mountain along this segment may provide roosting habitat for certain bat species. Habitat along segment A2 has not been greatly affected by logging, and it receives relatively little recreational use.

Along segment B1, habitat is generally suitable for bird and mammal species typical of lower elevation montane coniferous forest. Segment B1 passes to the north of the Glass Mountain Geologic Area, which may provide suitable bat habitat. As shown in Figure 3.7-3, wildlife habitats along segment B1 (progressing from west to east) are lodgepole pine forest, lower montane, mixed conifer forest, ponderosa pine forest, and ponderosa pine plantation. The lodgepole pine forest is moderately disturbed by logging, and a

large pumice mine is located along this segment to the north of the Glass Mountain Geologic Area.

Segment C1 supports a relatively low diversity of wildlife species, and includes some disturbed and early seral habitats. In the section of segment C1 west of the railroad line, there has been extensive alteration of the natural vegetation, and the quality of wildlife habitat is generally low. The dominant wildlife habitats in this area are ponderosa pine plantation and rabbitbrush shrub (see Figure 3.7-4). The eastern section of segment C1 includes interspersed sagebrush and juniper woodland that provides habitat for a range of wildlife species typical of the Modoc Plateau.

Segment A1 is in proximity to the Medicine Lake Glass Flow. Segment A2 comes within close proximity to the Glass Mountain Flow and two smaller lava flows. Segment B1 also is in close proximity to the Glass Mountain Flow at various points along the proposed transmission line route.

Special-Status Wildlife Species

Several special-status species are known to occur or have the potential to occur in the general vicinity of the study area of the proposed project. Table 3.8-1 presents a list of these species and indicates the official status for each. Table 3.8-2 provides information on the quality of available habitat for special-status species in the proposed project area, as well as the potential presence of species at each proposed project facility. A detailed discussion of known and potential special-status species presence in the project area and the location of suitable habitat for these species is provided below. This discussion of special-status species follows the order of species in Tables 3.8-1 and 3.8-2. Additional information on special-status wildlife species that are known to occur in the project area is available in the *Modoc National Forest Land and Resource Management Plan – Final Environmental Impact Statement* (USFS 1991) and *Klamath National Forest Land and Resource Management Plan - Final Environmental Impact Statement* (USFS 1994).

Bald Eagle: The bald eagle (*Haliaeetus leucocephalus*) is listed as a Federal Threatened and California Endangered Species, and is protected under the Bald and Golden Eagle Protection Act, as amended in 1962. This species has been observed within the project region in both summer and winter. The main center of bald eagle activity in the project region is on the south side of Medicine Lake, about 3.5 miles southeast of the wellfield and power plant area. There is no evidence that the bald eagle uses the wellfield and power plant area, although bald eagles have been observed at Modoc Lake, about 1.3 miles to the east, on the slopes of Mt. Hoffman. No suitable prey base exists in the wellfield and power plant area or along the freshwater pipeline study corridor.

Along the proposed transmission line route, two observations of the bald eagle have been made along segment A1 near Medicine Lake and in the vicinity of Alcohol Crater to the southeast of segment A1. Suitable habitat for the bald eagle does not exist on segments A2 and B1. Three winter roosting sites for the bald eagle are located in the vicinity of segment C1.

Table 3.8-1: Special Status Wildlife Species Occurring or With the Potential to Occur Within the Region of the Fourmile Hill Geothermal Development Project

Species	Federal[1]	California[2]	USFS[3]
Birds			
Bald eagle (*Haliaeetus leucocephalus*)	FT	SE	—
Blue grouse (*Dendrapagus obscurus*)	—	—	MIS
Cooper's hawk (*Accipiter cooperii*)	—	CSC	—
Golden eagle (*Aquila chrysaetos*)	—	CSC	MIS
Great gray owl (*Strix nebulosa*)	—	SE	R5
Greater sandhill crane (*Grus canadensis babida*)	—	ST	R5**
Hairy woodpecker (*Picoides villosus*)	—	—	MIS, SA
Loggerhead shrike (*Lanius ludovicanus*)	FSC	CSC	SA
Northern goshawk (*Accipiter gentilis*)	FSC	CSC	R5
Northern spotted owl (*Strix occidentalis caurina*)	FT	CSC	—
Osprey (*Pandion haliaetus*)	—	CSC	MIS
Pileated woodpecker (*Dryocopus pileatus*)	—	—	SA
Sage grouse (*Centrocercus urophasianus*)	—	CSC	MIS
Swainson's hawk (*Buteo swainsoni*)	—	ST	MIS, SA, R5*
Bats			
Fringed myotis (*Myotis thysanodes*)	FSC	CSC*[*]	PB
Long-eared myotis (*Myotis evotis*)	FSC	—	PB
Long-legged myotis (*Myotis volans*)	FSC	CSC*	PB
Pallid bat (*Antrozous pallidus*)	—	CSC	PB, R5*
Silver-haired bat (*Lasionycteris noctivagans*)	—	—	PB
Spotted bat (*Euderma maculatum*)	FSC	CSC	—
Townsend's big-eared bat (*Corynorhinus townsendii*)	FSC	CSC	PB, R5*
Western mastiff bat (*Eumops perotis*)	FSC	CSC	—
Western small-footed myotis (*Myotis ciliolabrum*)	FSC	—	—
Other Mammals			
American badger (*Taxidea taxus*)	—	CSC	—
American marten (*Martes americana*)	—	—	R5
California wolverine (*Gulo gulo luteus*)	FSC	CSC	R5**
Mule deer (*Odocoileus hemionus*)	—	—	MIS
Oregon snowshoe hare (*Lepus americanus klamathensis*)	—	CSC	—
Pacific fisher (*Martes pennanti pacifica*)	FSC	CSC	MIS
Pronghorn (*Antilocapra americana*)	—	—	MIS,SA
Sierra Nevada red fox (*Vulpes vulpes necator*)	—	—	R5 **
Invertebrates			
Klamath sideband (*Monadenia churchi*)	—	—	SM
Oregon shoulderband (*Helminthoglypta hertleini*)	—	—	SM
Papillose tail-dropper (*Prophysaon dubium*)	—	—	SM

Table 3.8-1: Special Status Wildlife Species Occurring or With the Potential to Occur Within the Region of the Fourmile Hill Geothermal Development Project (continued)

Notes:

[1] Federal USFWS status definitions:
FE Federal Endangered Species: Any species that is in danger of extinction throughout all or a significant portion of its range
FT Federal Threatened Species: Any species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range
FPE Federal Proposed Endangered: Species that have been proposed by the USFWS for listing as endangered
FSC Federal Species of Concern: species formerly listed as category 2 candidates, species which may be under threat of extinction but for which there is not sufficient biological information to support a proposed rule to list as threatened or endangered.

[2] State status definitions:
SE State Endangered: A native species or subspecies of animal that is in serious danger of becoming extinct throughout all or a significant portion of its range
ST State Threatened: A native species or subspecies that is likely to become an endangered species in the foreseeable future
CSC California species of Special Concern: Species whose state breeding populations are of special concern in that they may face extirpation, but that have not been listed as threatened or endangered
CSC* Included on 1996 preliminary list of revised CDFG Mammals of Special Concern

[3] USFS status definitions:
MIS Management Indicator Species: Species selected for planning emphasis in the Modoc National Forest LRMP. They are monitored during Forest Plan implementation to assess the effects of management activities.
SA Species Association: Species selected for planning emphasis in the Klamath National Forest LRMP. They are monitored during Forest Plan implementation to assess the effects of management activities.
SM Survey and Manage species under the Northwest Forest Plan
R5 USFS Region 5 sensitive species: Sensitive species are those identified by the Regional Forester where population viability is a concern.
R5* USFS Region 5 Sensitive species whose classification has changed subsequent to the publication of the Draft EIS/EIR.
R5** USFS Region 5 Sensitive species which were listed subsequent to the publication of the Draft EIS/EIR.
PB Protection Buffer: Species protected under the Northwest Forest Plan. Species managed to maintain viability throughout their range.

SOURCE: Leitner 1997; USFS 1998

Table 3.8-2: Special-Status Wildlife Species Use of the Proposed Project Area[1]

Species	Wellfield and Power Plant	Water Pipeline	A1	A2	B1	C1[2]
Birds						
Bald eagle	4	4	1 C	4	4	1C
Blue grouse	1 FRC	2 FRC	2 FRC	2 FRC	3	4
Cooper's hawk	1 FRC	2 FRC	2 FRC	2 FRC	2 FRC	4
Golden eagle	1 F	2 F	2 F	2 F	2 F	2 F
Great gray owl	4	4	2 F	4	4	4
Greater sandhill crane	4	4	4	4	4	3
Hairy woodpecker	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	3
Loggerhead shrike	4	4	4	4	4	1 FRC
Northern goshawk	1 FRC	1 FRC	2 FRC	1 FRC	2 FRC	4
Northern spotted owl	4	2 FRC	2 FRC	2 FRC	2 FRC	4
Osprey	4	3	1 C	2 C	4	4
Pileated woodpecker	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	4
Sage grouse	4	4	4	4	4	2 FRC
Swainson's hawk	4	4	4	4	4	2 FRC
Bats						
Fringed myotis	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC
Long-eared myotis	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	3
Long-legged myotis	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	3
Pallid bat	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC
Silver-haired bat	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	3
Spotted bat	4	4	4	4	4	4
Townsend's big-eared bat	2 FC	2 FC	2 FC	2 FC	2 FC	2 FC
Western mastiff bat	3	3	3	3	3	3
Western small-footed myotis	3	3	3	3	2 FRC	2 FRC
Other Mammals						
American badger	4	4	4	4	4	2 FRC
American marten	1 FRC	1 FRC	1 FRC	1 FRC	2 FRC	4
California wolverine	3	3	3	3	3	4
Mule deer	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	1 FC
Oregon snowshoe hare	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	4
Pacific fisher	3	3	3	3	3	4
Pronghorn	4	4	4	4	4	1 FRC
Sierra Nevada red fox	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	4
Invertebrates						
Klamath sideband	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	4
Oregon shoulderband	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	4
Papillose tail-dropper	2 FRC	2 FRC	2 FRC	2 FRC	2 FRC	4

Table 3.8-2: Special-Status Wildlife Species Use of the Proposed Project Area[1] (continued)

Legend:

1 = confirmed present
2 = suitable habitat/may be present
3 = marginal habitat
4 = no suitable habitat/unlikely to be present

F = foraging/hunting habitat
R = reproductive habitat
C = cover (resting/roosting habitat)

Notes:

[1] Designations reflect a conservative estimate, as a species may not utilize the entire area for a specific use.

[2] Includes proposed substation site.

SOURCE: MHA 1997; LEITNER 1997; USFS 1998

Blue Grouse: The blue grouse (*Dendrapagus obscurus*), a USFS Management Indicator Species, is resident in higher elevation coniferous forest throughout northern California. The blue grouse is often found in mid-seral to mature forests with patches of more open brush habitats. The blue grouse has been observed within the wellfield and power plant area. Suitable blue grouse habitat exists within the wellfield and power plant area, as well as along the freshwater pipeline corridor; the blue grouse is likely present year-around in these areas.

Along the proposed transmission line route, habitat on segments A1 and A2 is suitable for the blue grouse, and this species is probably present year-around along these segments. The blue grouse may be present at higher elevations along segment B1, although habitat quality is marginal along this segment. Suitable habitat is not available along segment C1, and there is no evidence that the species occurs in this area.

Cooper's Hawk: The Cooper's hawk (*Accipiter cooperii*) is a California Species of Special Concern that is found throughout northern California in wooded habitats. This species has been observed in the wellfield and power plant area, and suitable hunting and nesting habitat is present in both the wellfield and power plant area and along the freshwater pipeline corridor.

Along the proposed transmission line route, the Cooper's hawk likely utilizes segments A1, A2, and B1. Portions of these segments probably provide suitable hunting and nesting habitat for the Cooper's hawk. Segment C1 does not provide suitable habitat for this species and the Cooper's hawk is not present along this segment.

Golden Eagle: The golden eagle (*Aquila chrysaetos*) is a California Species of Special Concern and a USFS Management Indicator Species. The golden eagle is also protected by the Bald and Golden Eagle Protection Act, as amended in 1962. The golden eagle hunts within the entire project region; however, open country on the Modoc Plateau to the east provides the best foraging habitat. The area around Modoc Lake, about 1.3 miles east of Mt. Hoffman, may be used by the golden eagle for foraging. No nest sites have been recorded at the wellfield and power plant area or along the freshwater

pipeline corridor. Suitable foraging habitat exists in the wellfield and power plant area, as well as along the freshwater pipeline corridor.

The golden eagle may occasionally hunt along all segments of the proposed transmission line route. No nest sites have been recorded along segments A1, A2, and B1; however, a nest site has been observed south of the segment C1 study corridor.

Great Gray Owl: The great gray owl (*Strix nebulosa*), a California Endangered Species and a USFS Sensitive Species, is commonly found in dense stands of old growth red fir, lodgepole pine, or mixed conifer that are adjacent to preferred foraging habitat in meadows. Potential foraging habitat for this species exists around Modoc Lake and at the meadows near Medicine Lake to the south. There is no evidence that this species utilizes the wellfield and power plant area or the freshwater pipeline study corridor, and no suitable habitat for this species exists in these areas.

Along the proposed transmission line route, there is no evidence that the great gray owl utilizes segments A2, B1, or C1. Potential foraging habitat exists along segment A1 near Little Medicine Lake and just south of the Medicine Lake Glass Flow in the meadow areas.

Greater Sandhill Crane: The greater sandhill crane (*Grus canadensis babida*), a California Threatened Species and a USFS Sensitive Species, is found in shortgrass plains, grain fields, and open wetlands. Approximately 300 pairs are known to breed in northeastern California in Siskiyou, Modoc, Lassen, Plumas, and Sierra counties (Thelander and Crabtree 1994); some of these individuals may occur in the project area, particularly near State Highway 139. Potential greater sandhill crane breeding habitat does not exist in the immediate project vicinity but cranes could potentially move through the area from (1) potential breeding sites near the Oregon border (e.g., Lower Klamath Lake and Tule Lake) and sites to the south of the project site, during the breeding season, and (2) between potential breeding sites to the northeast of the project site (e.g., Clear Lake) and their wintering grounds in California's Central Valley.

As a result of their long-distance movement, the greater sandhill crane may cross the proposed and alternative transmission line segments C1 or C2.

Hairy Woodpecker: The hairy woodpecker (*Picoides villosus*) is a USFS Management Indicator Species that uses mature hardwood and coniferous forest throughout northern California. Good quality habitat for the hairy woodpecker is comprised of conifer stands with abundant snags and interspersed patches of shrub and herbaceous vegetation. Suitable habitat for the hairy woodpecker exists in the wellfield and power plant area and along the proposed freshwater pipeline; this species is very likely to be present in these areas.

Along the proposed transmission line route, the hairy woodpecker is likely to be present in suitable habitat along segments A1, A2, and B1. A few patches of large conifers provide marginal habitat for the hairy woodpecker in the western section of segment C1; the hairy woodpecker is less likely to be present along this segment.

Loggerhead Shrike: The loggerhead shrike (*Lanius ludovicianus*) is a USFWS Species of Concern and a California Species of Special Concern. The loggerhead shrike nests in the

thick foliage of shrubs and trees and hunts over the surrounding open country. The loggerhead shrike is not present in the wellfield and power plant area, or along the proposed freshwater pipeline, since there is no suitable habitat at these locations.

The proposed transmission line route may provide suitable habitat year-round for the loggerhead shrike along the eastern section of segment C1. Segments A1, A2, and B1 do not provide suitable habitat for the loggerhead shrike, and there is no evidence that the species occurs along these segments.

Northern Goshawk: The northern goshawk (*Accipiter gentilis*) is a Federal Species of Concern, a state Species of Special Concern, and a USFS Sensitive Species. The northern goshawk is resident in the Medicine Lake Highlands. Widespread sightings suggest that this species forages in a variety of forested habitats throughout this region.

The USFS has identified a nest site for the northern goshawk in the vicinity of the proposed wellfield and power plant. This nest site (referred to as the "Grouse Hill Goshawk Territory") is located more than 0.25 mile from the nearest project facilities. Suitable foraging habitat for the northern goshawk is present throughout the wellfield and power plant area, as well as along the freshwater pipeline study corridor. This species has been observed in the southern portion of the proposed freshwater pipeline corridor. The northern end of this corridor may lie within the home range of the Grouse Hill goshawk pair, but is located more than 0.6 miles from the nest stand.

Suitable foraging habitat for the northern goshawk is present along the entire length of Segment A1. The northern end of segment A1 may be within the Grouse Hill goshawk pair home range, but is more than 0.6 miles from the nest stand. The southern portion of segment A1 is not within a designated goshawk home range, but a number of observations of adult and immature goshawks have been made in this area. Evidence suggests that a nest site may be located in red fir habitat to the west of segment A1, more than 0.25 miles from the transmission line study corridor.

Along segment A2, the northern goshawk has been observed several times, and the entire segment is suitable for goshawk foraging habitat. Evidence suggests that a goshawk nest site may be located in the Alcohol Crater/Red Shale Butte area to the south of segment A2. This potential nest site is located over one miles from segment A2. Forest habitat with potential for goshawk nesting is found on the south side of Mt. Hoffman, upslope from segment A2; however, no nest structures have been found in this area.

Suitable foraging habitat for the northern goshawk is also located along segment B1, and this species may utilize this area occasionally. Segment C1 does not provide suitable habitat for the northern goshawk, and this species is not present along this segment.

Northern Spotted Owl: The northern spotted owl (*Strix occidentalis caurina*) is listed as a Federal Threatened Species and a California Species of Concern. The northern spotted owl was addressed in the Northwest Forest Plan (USFS and BLM 1994), which was prepared to provide a plan for the protection and enhancement of old-growth and late-successional forest ecosystems in Washington, Oregon, and northern California (see

Section 3.10-Plans and Policies for a detailed discussion of the Northwest Forest Plan). These types of ecosystems serve as the primary habitats for the northern spotted owl.

The majority of the project vicinity is designated as "Matrix" land allocation by the Northwest Forest Plan, and the standards and guidelines in the Plan for this designation apply (see Section 3.10-Plans and Policies). Subsequent to publication of the Northwest Forest Plan, the USFS was directed to designate three Managed Late-Successional Areas (MLSA) on the Modoc National Forest. These contiguous MLSA are located directly south of Medicine Lake and the Glass Mountain Geologic Area (see Figure 3.10-2 in Section 3.10-Plans and Policies). The standards and guidelines in the Northwest Forest Plan for MLSAs apply (see Section 3.10-Plan and Policies).

The nearest known northern spotted owl activity center is about 3.5 miles to the west of the wellfield and power plant area. This species was not detected in the wellfield and power plant area during field surveys. No suitable nesting or roosting habitat for the northern spotted owl exists within or adjacent to the wellfield and power plant area, and no preferred habitat for this species would be affected by the proposed project in this area (Galea and Oberlag 1996). Although possible foraging habitat is scattered through the wellfield and power plant area, it is unlikely that the northern spotted owl uses this area due to the fragmented condition of potential habitat.

Previous field surveys have not identified suitable habitat for the northern spotted owl along the temporary freshwater pipeline route, and no sign or detection of spotted owls have been made in this area (BLM et al. 1995). However, some of the forested habitats within 0.25 miles of this proposed pipeline route fit the definition of suitable northern spotted owl nesting and foraging habitat, as defined by the USFS Doublehead Ranger District.

Along the proposed transmission line route, no suitable nesting or foraging habitat was identified for the northern spotted owl by surveys conducted for the proposed project. In addition, no sign or detection of spotted owls have been recorded along the transmission line route. However, the USFS Doublehead Ranger District considers portions of the proposed transmission line located in the Medicine Lake Highlands (i.e., segments A1 and A2 and the western portion of segment B1) to traverse or be adjacent to suitable nesting and foraging habitat for the northern spotted owl. For more information on the northern spotted owl, see the Biological Assessment prepared for this project. This document is available for public review at the USFS office in Alturas, CA.

Osprey: The osprey (*Pandion haliaetus*) is a California Species of Special Concern and a USFS Management Indicator Species. The osprey uses the Medicine Lake area for foraging regularly in the summer. The osprey's fishing activities are concentrated at Medicine Lake, although foraging has also been observed at Bullseye Lake to the southeast of the project area. No evidence suggests that the osprey utilizes the wellfield and power plant area, and no suitable habitat is present for this species at this location. Some marginal roosting habitat may be provided for the osprey along the proposed freshwater pipeline.

Along the proposed transmission line route, the osprey often uses trees as perches near Medicine Lake along segment A1. The first active osprey nest in the Medicine Lake area

was reported in 1996 about 0.5 miles south of segment A1. In summer, the osprey often uses the Alcohol Crater area about 0.5 miles southeast of segment A2, where suitable habitat exists. No suitable habitat is available for the osprey along segments B1 and C1 of the proposed transmission line route.

Pileated Woodpecker: The pileated woodpecker (*Dryocopus pileatus*), a USFS Management Indicator Species, is usually found in large stands of mixed conifers. This species is an uncommon resident of the mountain areas of northern California. The pileated woodpecker is present in the project vicinity in the Medicine Lake Highlands, where there are large stands of mature red fir and mixed upper montane conifer forests. The pileated woodpecker has not been recorded in the wellfield and power plant area or along the freshwater pipeline corridor; however, suitable habitat exists in these areas, and this species is very likely to be present.

Along the proposed transmission line route, the pileated woodpecker may use mature forest habitats on segments A1, A2, and B1. Segment C1 does not provide suitable habitat for this species.

Sage Grouse: The sage grouse (*Centrocercus urophasianus*) is a California Species of Special Concern and a USFS Management Indicator Species. The sage grouse is an uncommon resident of the high semi-arid plateau country of northeastern California. This species requires extensive sagebrush stands for foraging and cover through most of the year, but is dependent on meadows as feeding areas in summer. Suitable habitat is not present at the wellfield and power plant area or along the freshwater pipeline corridor for this species, and the sage grouse has not been observed in these areas.

Along the proposed transmission line route, shrub habitat in the eastern section of segment C1 has the potential for sage grouse use in both summer and winter. Segments A1, A2, and B1 do not provide suitable habitat for the sage grouse, and there is no evidence that the species occurs along these segments.

Swainson's Hawk: The Swainson's Hawk (*Buteo swainsoni*) is a California Threatened Species and a USFS Sensitive species. The Swainson's hawk breeds in the open habitats of northeastern California, where it uses scattered trees as nest sites. This species migrates to the south in the fall and returns to northeastern California the following spring. The Swainson's hawk is not present at the wellfield and power plant area or along the proposed freshwater pipeline. Suitable habitat for the Swainson's hawk is not available in these areas.

Along the proposed transmission line route, the Swainson's hawk is likely to be present along segment C1, where suitable nesting sites are provided in scattered ponderosa pines and junipers and open shrublands may be used for hunting in the summer. Segments A1, A2, and B1 do not provide suitable habitat for the Swainson's hawk, and there is no evidence that the species occurs along these segments.

Fringed Myotis: The fringed myotis *(Myotis thysanodes)* is a Federal Species of Concern, a California Species of Special Concern, and a Northwest Forest Plan Protection Buffer species. This bat occurs in a wide range of habitats including coniferous forest. Diurnal roosts are located in large conifer snags and in rock crevices. This species is very likely

to occur throughout the project area, and all portions of the proposed project area provide suitable habitat for this bat.

Long-eared Myotis: The long-eared myotis (*Myotis evotis*) is a Federal Species of Concern and a Northwest Forest Plan Protection Buffer species. The long-eared myotis is primarily associated with montane coniferous forest in northern California. Diurnal roosts have been reported in tree cavities, under exfoliating bark, and in rock crevices. This bat is very likely to be present throughout the Medicine Lake Highlands, where suitable roosting habitat is available. Suitable habitat for this species is present in the wellfield and power plant area, the freshwater pipeline, and along proposed transmission line segments A1, A2, and B1. Only marginal habitat is provided along segment C1, where this species is unlikely to be present.

Long-legged Myotis: The long-legged myotis *(Myotis volans)* is a Federal Species of Concern, a California Species of Special Concern, and a Northwest Forest Plan Protection Buffer species. The long-legged myotis has been recorded in a wide variety of habitats in California, including juniper woodland and montane conifer forest. Although this bat uses caves, mines, buildings, and rock crevices as roost sites, it appears to select large snags (esp. ponderosa pine) where available. Suitable habitat for this species is present in the wellfield and power plant area, along the freshwater pipeline, and along proposed transmission line segments A1, A2, and B1. Only marginal habitat is provided along segment C1, where this species is unlikely to be present.

Pallid Bat: The pallid bat (*Antrozous pallidus*), a California Species of Special Concern and a USFS Sensitive species, is found in a wide variety of habitats in California, from deserts to coniferous forests. This species uses a variety of diurnal roosts, including caves, rock outcrops, and trees with cavities or exfoliating bark. The pallid bat is very likely to occur throughout the project area, and all portions of the proposed project area provide suitable habitat for this bat.

Silver-haired Bat: The silver-haired bat (*Lasionycteris noctivagans*), a Northwest Forest Plan Protection Buffer species, is widespread in coniferous, forest habitat in northern California, often at high elevations. Summer roosts are almost exclusively in large trees, where it uses cavities and exfoliating bark. It can travel considerable distances between roost sites and foraging habitat. The silver-haired bat is very likely to be present in the Medicine Lake Highlands and may be associated with mature forest stands. Suitable habitat for this species is present in the wellfield and power plant area, the freshwater pipeline, and along proposed transmission line segments A1, A2, and B1. Only marginal habitat is provided along segment C1, where this species is unlikely to be present.

Spotted Bat: The spotted bat (*Euderma maculatum*) is a Federal Species of Concern and a California Species of Special Concern. The spotted bat is rare and has a patchy distribution throughout the western U.S. It uses crevices on extensive vertical cliff faces as diurnal roosting habitat. The absence of such cliff habitat in the project area makes it very unlikely that the species is present in any portion of the proposed project facilities or along the transmission line routes.

Townsend's Big-eared Bat: The Townsend's big-eared bat (*Corynorhinus townsendii*), a Federal Species of Concern, a California Species of Concern, and a USFS Sensitive species, is known from the Lava Beds National Monument to the north of the project area. The Townsend's big-eared bat is commonly found in caves and lava tubes that serve both as summer maternity roosts and winter hibernacula. This species is expected to occur on the Modoc Plateau, where caves and lava tubes are present. The Townsend's big-eared bat has not been recorded in the wellfield and power plant area or along the freshwater pipeline study corridor. High quality roosting habitat (in the form of caves, mines, or buildings) does not exist on the wellfield and power plant area; however, large spaces within the rocky matrix of the Grouse Hill Glass Flow and the Medicine Lake Glass Flow (Figure 3.7-2) may provide diurnal shelter during the summer, and this species is very likely to be present in these areas.

Suitable habitat is available for the Townsend's big-eared bat along the proposed transmission line route, and this species is very likely to be present along all of the proposed segments. Along segment A1, large spaces within the rocky matrix of the Medicine Lake Glass Flow may provide diurnal shelter during the summer. However, there is no high quality roosting habitat in the form of caves, mines, or buildings on segment A1. Along segment A2, extensive lava flows and rock outcrops are present that may provide diurnal roosting habitat during the summer. Segment B1 does not provide caves, but rocky cliffs on the edge of the Glass Mountain Lava Flow may provide diurnal roosting habitat during the summer. A cave within the segment C1 study corridor may provide diurnal, roosting habitat during the summer and could potentially be a hibernating site.

Western Mastiff Bat: The western mastiff bat (*Eumops perotis*), a Federal Species of Concern and a California Species of Special Concern, is a large, high-flying bat that has been recorded once in the Medicine Lake Highlands. It is possible that individuals could forage over the project area occasionally in summer, but the lack of suitable diurnal roosting habitat (in the form of cliff faces or vertical rock outcrops) makes it unlikely that this species is resident in the project area. All portions of the proposed project could provide occasional foraging habitat for this species, although it is unlikely to find roosting habitat in or near any of the project facilities.

Western Small-footed Myotis: The western small-footed myotis (*Myotis ciliolabrum*), a Federal Species of Concern, is widely distributed in California and is found in a variety of habitats, including juniper woodland, ponderosa pine forest, and lower montane mixed conifer forest. Diurnal roosts have been found in trees and mines. This species is very likely to be present within the project area, especially on the Modoc Plateau and on the eastern slopes of the Medicine Lake Highlands, where suitable juniper woodland and ponderosa pine forests are located. Only marginal habitat is provided at the wellfield and power plant area, along the freshwater pipeline, and along proposed transmission line segments A1 and A2. Segments B1 and C1 provide suitable habitat for the western small-footed myotis, and this species is very likely to be present along these segments.

American Badger: The American badger (*Taxidea taxus*) is a California Species of Special Concern. Suitable habitat for the American badger occurs throughout the project area on the Modoc Plateau, and consists of juniper woodland, open ponderosa pine

forest, and shrub-dominated habitat. No suitable habitat is available for this species in the wellfield and power plant area or along the freshwater pipeline, and there is no evidence that the species occurs in these areas.

Along the proposed transmission line route, suitable habitat for the American badger exists in open shrub and woodland habitat along segment C1. Segments A1, A2, and B1 do not provide suitable habitat for the American badger and there is no evidence that this species may occur along these segments.

American Marten: The American marten (*Martes americana*) is a USFS Sensitive Species. Mature coniferous forest with dense canopy provides the highest quality habitat for this species. Potential denning habitat can include areas with large snags, abundant large-sized downed wood, or rocky outcrops. The American marten has been observed regularly throughout the Medicine Lake Highlands and is known to use all timber types in this region, including lodgepole pine forest (Villegas 1997, personal communication). Martens have been observed foraging in the wellfield and power plant area and along the freshwater pipeline study corridor, although no den sites have been identified in either area.

Along the proposed transmission line route, the American marten has been observed in the vicinity of segments A1 and A2. Past observations indicate that good quality habitat is present along these segments. No specific den sites have been identified along segments A1 or A2. The American marten may utilize forested habitat along segment B1 down to the 5,000 feet elevation. Suitable habitat for this species does not exist along segment C1.

California Wolverine: The California wolverine (*Gulo gulo luteus*) is listed as threatened by the CDFG, as a species of concern by the USFWS, and as a USFS Sensitive species. This subspecies is found in remote areas of the North Coast, Cascade, and Sierra mountain ranges of California and Oregon (CDFG 1988; Thelander and Crabtree 1994). It is apparently extremely wary of humans. As a result, the wolverine has rarely been seen in this century in California. Indeed, there has been no specimen or photograph taken of this subspecies in California in over 50 years. However, there have been several reliable sightings of this species in California during that time, including one from the late 1980's about 30 miles west of the project area. The California wolverine is thought to have never been common, but may be declining more recently due to loss of remote coniferous forest habitat that is free of human disturbance.

This hypothesized historic and current range of the California wolverine includes the project site within Siskiyou County and the extreme western edge of Modoc County (Zeiner et al. 1990; Thelander and Crabtree 1994). The proposed transmission line corridors C1 and C2 are in lower elevation woodland and scrubland habitat that is likely outside of the range of the California wolverine.

The California wolverine's apparent sensitivity to human activity probably restricts most of its range to regions that are already free of such activity. These areas might include designated wilderness and other roadless areas where humans seldom travel. However, there have been sightings of wolverine near campgrounds and recreational areas in California, indicating that wolverines do venture into more disturbed areas. Between 1983 and 1995, there were 11 unverified reports of wolverines or their tracks

on the McCloud and Mount Shasta Ranger Districts of the Shasta-Trinity National Forest (D. Oberlag, personal communication, 1998). The proposed project would cross habitat that contains roads and supports human activities that may already exclude the California wolverine. Marginally-suitable habitat for this species may exist in the forested habitats in the project area, including the wellfield and power plant area, and transmission line segments A1, A2, and B1.

Mule Deer: The mule deer (*Odocoileus hemionus*), a USFS Management Indicator Species, is commonly found in mid-seral shrub, woodland, or forest habitats, interspersed with open herbaceous patches and abundant water sources. The mule deer has been not observed in the wellfield and power plant area or along the freshwater pipeline corridor; however, moderate quality summer range exists in these areas and the mule deer is very likely to be present.

Along the proposed transmission line route, moderate quality habitat is present along segments A1 and A2, and is probably used by the mule deer for foraging during the summer. This habitat consists of small dry meadows and patches of herbaceous vegetation. Higher elevation habitat on segment B1 may be used as summer range, and the mule deer moves through the area during spring and fall migrations. The mule deer of both the Glass Mountain and California-Oregon Interstate herds utilize segment C1 as winter habitat.

Oregon Snowshoe Hare: The Oregon snowshoe hare (*Lepus americanus klamathensis*) is a California Species of Special Concern. Suitable habitat for the Oregon snowshoe hare consists of dense cover provided by the early seral stages of conifer forest, patches of montane chaparral, and riparian thickets. Suitable habitat is available throughout the Medicine Lake Highlands for this species. The Oregon snowshoe hare is likely to be present year-around in the wellfield and power plant area and along the freshwater pipeline study corridor, where suitable habitat exists.

Along the proposed transmission line route, suitable snowshoe hare habitat exists along segments A1, A2, and B1. The snowshoe hare may potentially be present year-round in these areas. Suitable habitat is not provided for the Oregon snowshoe hare along segment C1, and this species is not likely to be present along this segment.

Pacific Fisher: The Pacific fisher (*Martes pennanti pacifica*) is a Federal Species of Concern, a California Species of Special Concern, and a USFS Sensitive Species. The Pacific fisher is commonly found in areas of extensive stands of mature, dense forest with a high level of canopy closure. Two historic sightings of the Pacific fisher were recorded from the vicinity of Medicine Lake, but these may have been dispersing individuals. No evidence exists of a resident population in the vicinity of the wellfield and power plant area or along the freshwater pipeline corridor. Only marginal habitat is available for the Pacific fisher in these areas, and this species is unlikely to be present.

Along the proposed transmission line route, two historic sightings of Pacific fisher have been recorded in the vicinity of Medicine Lake near segments A1 and A2. These sightings may have recorded dispersing individuals. No evidence exists of a resident population along any of the transmission line segments. Marginal habitat is available for the Pacific fisher along segments A1, A2, and B1, where this species is unlikely to be present. Suitable habitat for the Pacific fisher does not exist along segment C1.

Pronghorn: The pronghorn (*Antilocapra americana*), a USFS Management Indicator Species, is typical of many Great Basin species that reach their western limits in the open grasslands, sagebrush shrub, and juniper woodlands of the Modoc Plateau. Suitable habitat for the pronghorn is not provided in the wellfield and power plant area or along the freshwater pipeline, and this species is not present in these areas.

Along the proposed transmission line route, segment C1 provides open shrub habitat used throughout the year by the pronghorn. Segments A1, A2, and B1 do not provide suitable habitat for the pronghorn, and there is no evidence that the species occurs along these segments.

Sierra Nevada Red Fox: The Sierra Nevada red fox is listed as threatened by the CDFG, as a species of concern by the USFWS, and a USFS Sensitive species. The Sierra Nevada red fox (*Vulpes vulpes necator*) is an extremely rare species that was once found in the Cascade Range from Siskiyou County south along the crest of the Sierra Nevada Range as far south as Tulare County. Its current range is assumed to be similar to its historic range. This species occurs in mid to high elevations of these mountain ranges but is seldom seen there (Zeiner et al. 1990; Thelander and Crabtree 1994).

The Sierra Nevada red fox was historically found in the Mt. Lassen area, and at one time was found in the Medicine Lake Highlands. However, there has been no confirmed record of this species occurring in the project area since 1934, when an individual was trapped at Medicine Lake (Galea Wildlife Consulting 1995). There were two unconfirmed sightings of Sierra Nevada red fox in 1989 on the Shasta-Trinity National Forest about 2 and 5 miles south of Little Glass Mountain (D. Oberlag, personal communication, 1998). This species occurs in several forest types, including red fir, lodgepole pine, and mixed conifer stands (Zeiner et al. 1990), all of which are present in the power plant and wellfield area and along transmission line segment A1. The species is currently not known to occur in Modoc County, although suitable habitat may be present for this species along segments A2 and B1.

Klamath Sideband: The Klamath sideband (*Monadenia churchi*) is a Survey and Manage terrestrial mollusk. The range of the Klamath sideband includes Shasta, Siskiyou, Trinity, Tehama, and Butte counties. This species prefers habitat consisting of limestone outcrops, caves, and talus sides but is also found in lava rockslides, especially in riparian areas, and under nearby forest debris in heavy shade.

Potential habitat for the Klamath sideband exists in the wellfield and power plant area. Suitable habitat for this species may also be present along transmission line segments A1, A2, and B1.

Oregon Shoulderband: The Oregon shoulderband (*Helminthoglypta hertleini*) is a Survey and Manage terrestrial mollusk. This species' range includes the Klamath Province from Jackson County, Oregon, to Siskiyou County, California. This species prefers areas with permanent ground cover and available moisture. Other characteristics of Oregon shoulderband habitat include large woody debris and rock fissure sites.

Potential habitat exists for the Oregon shoulderband in the proposed wellfield and power plant area, and along transmission line segments A1, A2, and B1 where rocky areas or areas of large woody debris are present.

Papillose Tail-dropper: The papillose trail-dropper (*Prophysaon dubium*), a Survey and Manage species, ranges from the eastern slopes of the Washington Cascade Range to the Olympic Mountains, and south into northern California. This species prefers areas with large woody debris and leaf litter in moist conifer and mixed conifer forests.

Potential habitat for this species exists in the wellfield and power plant area, and along transmission line segments A1, A2, and B1 where areas of large woody debris and leaf litter are present.

Other Survey and Manage Mollusks. Three other terrestrial mollusk species that are survey and manage are expected or known to occur on the Goosenest Ranger District of the Klamath National Forest, according to the Draft Terrestrial Mollusk Survey Protocol. These species are not expected to occur in the project area because of a lack of suitable habitat. Two species of *Trilobopsis* are associated with exposed limestone, which is not present in the project area. *Monadenia chaceana* is the only species known to occur on the Goosenest Ranger District (near the Little Shasta River about 35 miles west of the project area). This species is restricted to rocky shrub steppe to pine-oak woodland; this habitat is also absent from the project area. *M. chaceana* is not thought to occur on the Modoc National Forest.

ALTERNATIVES

The affected environment for each alternative to the proposed action is described below. For Alternatives 2 through 6, the affected environment for the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of existing environment along these portions of the transmission line are not repeated under each alternative discussion. The description of the affected environment focuses on the segments of the transmission line that would be different from those in the proposed action. Table 3.8-3 summarizes the information provided below. The quality of available habitat for special-status species and the potential presence of species at each alternative transmission line route is also described.

Alternative 2 (A1, A2, B1, and C2)

Under Alternative 2, transmission line segment C2 would replace segment C1, and one of the two alternate substation sites at the eastern terminus of segment C2 would be developed. The affected environment for the power plant and wellfield area, and transmission line segments A1, A2, and B1 would be the same under this alternative as described above for the proposed action. The existing environment along segment C2 and the alternate substation sites for wildlife is described below.

Segment C2: *General Wildlife Habitats:* The quality of wildlife habitat is generally low in the western section of segment C2, where there has been extensive alteration of the natural vegetation. The western portion of segment C2 supports wildlife species typical of disturbed and early seral habitats. This portion of the segment is predominantly

ponderosa pine plantation and sagebrush shrub (see Figure 3.7-8). The eastern section of this segment is sagebrush shrub interspersed with rabbitbrush shrub and juniper woodland. These habitat types support the range of wildlife species typical of the Modoc Plateau. Also, segment C2 skirts the southern edge of a lava flow north of Dry Lake, which may provide suitable habitat for bats.

Special-Status Wildlife Species: A number of special-status wildlife species are known to be present in the vicinity of segment C2, and have the potential to use the segment C2 study corridor (see Table 3.8-3). In addition, suitable habitat is present for other special-status species that do not have a confirmed presence along this segment.

- **Bald eagle.** Three winter roosting sites for the bald eagle are known in the vicinity of segment C2.
- **Greater sandhill crane.** The greater sandhill crane may fly over the area in the vicinity of segment C2 during the breeding season.
- **Golden eagle.** Suitable habitat for hunting is provided along segment C2, and a nest site is about 3 miles south of the study corridor.
- **Hairy woodpecker.** Potential habitat for the hairy woodpecker exists in the western section of segment C2, where a few patches of large conifers are present.
- **Loggerhead shrike.** In the eastern section of segment C2, juniper and large shrubs may provide nesting habitat for the loggerhead shrike.
- **Sage grouse.** Shrub habitat in the eastern section of segment C2 may be used by the sage grouse in both summer and winter. Strutting ground for the sage grouse has been reported northeast of Dry Lake, approximately 0.5 miles south of the study corridor.
- **Swainson's hawk.** Scattered ponderosa pines and junipers provide suitable nesting sites and the surrounding open shrublands may be used for hunting in summer. The Swainson's hawk is very likely to be present along segment C2.
- **Fringed myotis.** Suitable habitat for the fringed myotis for foraging, reproduction, and roosting exists along segment C2.
- **Long-eared myotis.** Marginal habitat is present for the long-eared myotis along segment C2; this species is unlikely to be present.
- **Long-legged myotis.** This species is unlikely to be present along segment C2 because only marginal habitat is present.
- **Pallid bat.** Suitable habitat for the pallid bat is present along segment C2, and this species is likely to be present.
- **Silver-haired bat.** The silver-haired bat is unlikely to be present along segment C2, where only marginal habitat is provided.
- **Townsend's big-eared bat.** A cave in the vicinity of segment C2 study corridor on the Modoc Plateau may provide diurnal roosting habitat during the summer, and may also be a hibernating site.
- **Western mastiff bat.** Marginal foraging habitat is present for the western mastiff bat along segment C2, but this species is unlikely to be regularly present at this location.
- **Western small-footed myotis.** Suitable habitat for the western small-footed myotis for foraging, reproduction, and roosting exists along segment C2.
- **American badger.** Suitable habitat for the American badger exists throughout the open shrub and woodland habitats along segment C2.

Table 3.8-3: Special-Status Wildlife Species Use of the Alternative Transmission Line Route Segments[1]

	A3	B2	C2[3]
Alternatives*	5, 6[2]	3, 4[2]	2, 4, 6[2]
Species			
Birds			
Bald eagle	4	3 C	1F
Blue grouse	2 FRC	2 FRC	4
Cooper's hawk	2 FRC	2 FRC	4
Golden eagle	2 F	2 F	2 F
Great gray owl	4	4	4
Greater sandhill crane	4	4	3
Hairy woodpecker	2 FRC	2 FRC	2 FRC
Loggerhead shrike	4	4	2 FRC
Northern goshawk	1 FRC	1 FRC	4
Northern spotted owl	2 FRC	1 FRC	4
Osprey	4	1 C	4
Pileated woodpecker	2 FRC	2 FRC	4
Sage grouse	4	4	2 FRC
Swainson's hawk	4	4	2 FRC
Bats			
Fringed myotis	2 FRC	2 FRC	2 FRC
Long-eared myotis	2 FRC	2 FRC	3
Long-legged myotis	2 FRC	2 FRC	3
Pallid bat	2 FRC	2 FRC	2 FRC
Silver-haired bat	2 FRC	2 FRC	3
Spotted bat	4	4	4
Townsend's big-eared bat	2 FC	1 FC	2 FC
Western small-footed myotis	3	2 FRC	2 FRC
Western mastiff bat	3	3	3
Other Mammals			
American badger	4	4	2 FRC
American marten	1 FRC	1 FRC	4
California wolverine	3	3	4
Mule deer	2 FRC	2 FRC	1 FC
Oregon snowshoe hare	2 FRC	2 FRC	4
Pacific fisher	3	3	4
Pronghorn	4	4	1 FRC
Sierra Nevada red fox	2 FRC	2 FRC	4
Invertebrates			
Klamath sideband	2 FRC	2 FRC	4
Oregon shoulderband	2 FRC	2 FRC	4
Papillose tail-dropper	2 FRC	2 FRC	4

Table 3.8-3: Special-Status Wildlife Species Use of the Alternative Transmission Line Route Segments[1] (continued)

Legend:

1	=	confirmed present	F	=	foraging/hunting habitat
2	=	suitable habitat/may be present	R	=	reproductive habitat
3	=	marginal habitat	C	=	cover (resting/roosting habitat)
4	=	no suitable habitat/unlikely to be present			

[1] Designations reflect a conservative estimate, as a species may not utilize the entire area for a specific use.

[2] Alternatives in which segment is included.

[3] Includes alternative substation sites.

SOURCE: MHA AND LEITNER 1997

- **Mule deer.** The Glass Mountain and California-Oregon Interstate herds of the mule deer use the area along segment C2 as winter habitat.
- **Pronghorn.** The pronghorn uses the more open shrub habitats throughout the year.

The following special-status species are not known to occur in the vicinity of segment C2, and do not have suitable habitat within this segment:

- Blue grouse
- Cooper's hawk
- Great gray owl
- Northern goshawk
- Northern spotted owl
- Osprey
- Pileated woodpecker
- Spotted bat
- American marten
- California wolverine
- Oregon snowshoe hare
- Pacific fisher
- Sierra Nevada red fox
- Klamath sideband
- Oregon shoulderband
- Papillose tail-dropper

Alternative 3 (A1, B2, and C1)

Under Alternative 3, transmission line segment B2 would replace segments A2 and B1. The affected environment for the power plant and wellfield area, and transmission line segments A1 and C1 would be the same under this alternative as described above for

the proposed action. The existing environment along segment B2 for wildlife is described below.

Segment B2: *General Wildlife Habitats:* Wildlife habitat in the western third of segment B2 is generally suitable for bird and mammal species typical of disturbed early to mid-seral higher elevation coniferous forest. This portion of segment B2 passes through the Medicine Lake Highlands MLSA. Wildlife habitat in this portion of segment B2 is predominately upper montane mixed conifer forest (see Figure 3.7-6). Some stands of relatively undisturbed forest habitat remain in steep terrain in the vicinity of Lyons Peak and Red Shale Butte, and these stands may have value for wildlife that require mature or late seral stage forest. In the remaining eastern portion of this segment (i.e., below about 4,800 feet), wildlife habitat is generally suitable for those bird and mammal species adapted to relatively open lower montane mixed conifer forest and ponderosa pine forest with a substantial component of shrub cover (see Figures 3.7-6 and 3.7-7).

Special-Status Wildlife Species: A number of special-status wildlife species are known to be present in the vicinity of segment B2, and have the potential to use habitat along this segment (see Table 3.8-3). In addition, suitable habitat is present for other special-status species whose presence has not been confirmed along this segment.

- **Bald eagle.** Two observations of the bald eagle in the vicinity of Alcohol Crater on the western edge of the segment B2 study corridor were made in 1984. Since 1984, no further sightings have been made in this area. Marginal summer roosting habitat for the bald eagle may be located along this segment.
- **Blue grouse.** Habitat in the higher elevation portions of the western half of segment B2 is suitable for the blue grouse, and this species is probably present year-around.
- **California wolverine.** Suitable habitat for the California wolverine may be present in the forested areas of the project, particularly in the vicinity of Red Shale Butte and Lyons Peak.
- **Cooper's hawk.** Suitable hunting and nesting habitat for the Cooper's hawk is present in the area surrounding segment B2; this species probably uses the area.
- **Golden eagle.** The golden eagle may occasionally hunt through the area surrounding segment B2, where suitable foraging habitat exists.
- **Hairy woodpecker.** Suitable habitat is present for the hairy woodpecker along segment B2; this species is very likely present in this area.
- **Northern goshawk.** Several sightings of the northern goshawk have been made along the segment B2 study corridor. The entire area along segment B2 is suitable as goshawk foraging habitat. Goshawks have been recorded in the Alcohol Crater/Red Shale Butte area through which the segment B2 study corridor passes. In addition, the Undertaker Goshawk Territory is located 2 miles southeast of Lyons Peak and about 1 mile south of the segment B2 study corridor.
- **Northern spotted owl.** Forested habitat that meets the definition of suitable northern spotted owl foraging and nesting habitat (as defined by the USFS Doublehead Ranger District) occurs in and near the segment B2 study corridor.
- **Osprey.** In summer, the osprey often uses the Alcohol Crater area on the western edge of the study corridor.
- **Pileated woodpecker.** Some good quality habitat is present for the pileated woodpecker, and this species may use the higher elevation, western portion of the segment B2 study corridor.

- **Fringed myotis.** The fringed myotis is very likely to be present along segment B2, where suitable habitat that could provide diurnal roosting is available.
- **Long-eared myotis**. Suitable habitat with diurnal roosting exists for this species along segment B2 .
- **Long-legged myotis.** The long-legged myotis is very likely to be present along segment B2, where suitable habitat is available.
- **Pallid bat.** Suitable habitat for the pallid bat is present along segment C2, and this species is likely to be present.
- **Pallid bat.** Habitat that could provide diurnal roosting is available in the eastern portion of segment B2, where the pallid bat is very likely to be present.
- **Silver-haired bat**. The silver-haired bat is very likely to be present along segment B2, where suitable forested habitat that could provide diurnal roosting is available.
- **Townsend's big-eared bat.** Extensive lava flows and rock outcrops are present in and near the segment B2 study corridor near the Glass Mountain Lava Flow. These features may provide diurnal roosting habitat during the summer for the Townsend's big-eared bat. A Townsend's big-eared bat hibernaculum is known to be located near segment B2 (Villegas 1997, personal communication).
- **Western small-footed myotis.** The western small-footed myotis is very likely to be present along segment B2, where suitable habitat that could provide diurnal roosting is available.
- **Western mastiff bat.** Only marginal foraging habitat is available for the western mastiff bat along segment B2. A single detection of the western mastiff bat has been documented in the general area around Alcohol Crater.
- **American marten.** Numerous sightings in the higher elevation, western portion of segment B2 over the past 20 years indicate that good quality habitat is present for the American marten. Although no specific den sites are known, areas with large snags, abundant large-sized, downed wood, and rocky outcrops are the most likely locations.
- **Mule deer.** The mule deer probably uses the higher elevation, western portion of the study corridor as summer range, although there is little high quality habitat. This species would be expected to move through the lower elevation eastern area during spring and fall migrations.
- **Oregon snowshoe hare.** Habitat on the higher elevation, western portion of the study corridor is suitable for the snowshoe hare year-around.
- **Pacific fisher**. Two sightings of the Pacific fisher have been recorded from the vicinity of Medicine Lake, but these may have been dispersing individuals. No evidence exists to indicate that there is a resident population of the Pacific fisher in this area; only marginal habitat exists.
- **Sierra Nevada red fox.** Although this species is not currently known to occur in Modoc County, suitable habitat may exist in the lodgepole pine and mixed conifer forest in the western portion of segment B2.
- **Klamath sideband**. Potential habitat for this species may exist along segment B2 in forested or rocky areas with woody debris.
- **Oregon shoulderband.** Potential habitat for this species exists along segment B2 in areas of permanent ground cover, large woody debris, and rocky outcrops.
- **Papillose tail-dropper.** Potential habitat for the papillose tail-dropper exists along segment B2 in areas with large woody debris and leaf litter.

The following special-status species are not known to occur in the vicinity of segment B2, and do not have suitable habitat within this segment:

- Great gray owl
- Greater sandhill crane
- Loggerhead shrike
- Sage grouse
- Swainson's hawk
- Spotted bat
- American badger
- Pronghorn

Alternative 4 (A1, B2, and C2)

Under Alternative 4, transmission line segment B2 would replace segments A2 and B1, and segment C2 would replace segment C1. The affected environment for the power plant and wellfield area, and transmission line segment A1 would be the same under this alternative as described above for the proposed action. Existing conditions along segments B2 and C2 are described above under Alternatives 3 and 2, respectively.

Alternative 5 (A3, B1, and C1)

Under Alternative 5, transmission line segment A3 would replace segments A1 and A2. The affected environment for the power plant and wellfield area, and transmission line segments B1 and C1 would be the same under this alternative as described above for the proposed action. The existing environment along segment A3 is described below.

Segment A3: *General Wildlife Habitats:* Wildlife habitat on segment A3 is generally suitable for bird and mammal species typical of disturbed early to mid-seral higher elevation coniferous forest. The portion of segment A3 that extends from the proposed power plant site to approximately Fourmile Hill passes through primarily upper montane mixed conifer forest and lodgepole pine forest (see Figure 3.7-5). From Fourmile Hill to its eastern endpoint, segment A3 passes through predominately upper montane mixed conifer forest. To the north of this portion of segment A3, is an extensive area of lodgepole pine forest that has been heavily logged. To the south of this portion of segment A3 are the north-facing slopes of Mount Hoffman. Large stands of undisturbed late seral forest cover these slopes, and these stands have important value as habitat for several special-status wildlife species.

Special-Status Wildlife Species: A number of special-status wildlife species are known to be present in the vicinity of segment A3, and have the potential to use habitat along this segment. (see Table 3.8-3). In addition, suitable habitat is present for other special-status species that do not have a confirmed presence along this segment.

- **Blue grouse.** Habitat on the segment A3 study corridor is suitable for the blue grouse, which is probably present year-round in this area.
- **Cooper's hawk.** Suitable hunting and nesting habitat is present for the Cooper's hawk, and this species is expected to use the habitat along this segment. A reproductive pair of Cooper's hawk is located approximately 0.25 miles from segment A3 (Villegas 1997, personal communication).

- **Golden eagle.** The golden eagle may occasionally hunt through this area, where suitable foraging habitat is present.
- **Hairy woodpecker.** Suitable habitat for the hairy woodpecker exists along segment A3, where this species is likely to be present.
- **Northern goshawk.** A portion of the A3 study corridor is considered to be within the home range of the goshawk pair that nests near Grouse Hill. Suitable foraging habitat for the northern goshawk is present throughout the area, and a number of goshawk observations have been recorded.
- **Northern spotted owl.** Forested habitat that meets the definition of suitable northern spotted owl foraging and nesting habitat (as defined by the USFS Doublehead Ranger District) occurs in and near the segment A3 study corridor.
- **Pileated woodpecker.** Suitable foraging habitat is available for the pileated woodpecker along this segment, and this species is likely to use habitat along this segment.
- **Fringed myotis.** Suitable roosting habitat is available for the fringed myotis along this segment, and it is very likely present in a variety of habitat features that could provide suitable diurnal roosting habitat.
- **Long-eared myotis.** A variety of habitat features could provide suitable diurnal roosting habitat along this segment for the long-eared myotis.
- **Long-legged myotis**. Suitable habitat exists for the long-legged myotis along segment A3, and it is very likely that this species is present.
- **Pallid bat.** Suitable habitat for the pallid bat is present along segment A3, and this species is likely to be present.
- **Silver-haired bat**. The silver-haired bat probably uses the suitable diurnal roosting habitat provided along segment A3.
- **Townsend's big-eared bat.** This species is likely to be present along this segment, where large spaces within rocky outcrops on the slopes of Fourmile Hill and on the Grouse Hill Glass Flow may provide diurnal shelter during the summer. However, no high quality roosting habitat in the form of caves is present for the Townsend's big-eared bat along segment A3.
- **Western small-footed myotis.** Marginal habitat for the western small-footed myotis exists along segment A3, but this species is unlikely to be present in this area.
- **Western mastiff bat.** The western mastiff bat is unlikely to be present along segment A3 because only marginal habitat exists in this area.
- **American marten.** Good quality habitat is available for the American marten along this segment, and several sightings of this species have been recorded. Although no specific den sites are known, areas with large snags, abundant, large-sized, downed wood, and rocky outcrops are the most likely locations for dens. The north-facing slopes of Mt. Hoffman provide excellent habitat for the American marten.
- **California wolverine.** Marginally-suitable habitat for the California wolverine may exist along segment A3 due to this species' very large home range and the level of human use in and near the Medicine Lake Highlands. Marginally-suitable habitat for this species may also be present south of segment A3 on the north-facing slopes of Mount Hoffman.
- **Mule deer.** Suitable habitat for the mule deer, particularly summer range of moderate quality, exists along segment A3, and this species is likely to be present.
- **Oregon snowshoe hare.** The Oregon snowshoe hare is probably present year-round along this segment, where suitable habitat exists.

- **Pacific fisher.** Two historic sightings of the Pacific fisher from the vicinity of Medicine Lake have been recorded, but these individuals may have been dispersing. No evidence exists to indicate that a resident population is located in this area, and no evidence exists to indicate that a resident population is located along segment A3.
- **Sierra Nevada red fox.** Suitable habitat for this species is present along segment A3 in lodgepole pine and mixed conifer forest.
- **Klamath sideband.** Suitable habitat for the Klamath sideband exists along segment A3 in areas of rock outcroppings and shaded forest debris.
- **Oregon shoulderband.** Oregon shoulderband habitat exists along segment A3 in areas with permanent ground cover, large woody debris, and rocky outcroppings.
- **Papillose tail-dropper.** Suitable habitat for the papillose tail-dropper exists along segment A3 in areas with extensive leaf litter and large woody debris.

The following special-status species are not known to occur in the vicinity of segment A3, and do not have suitable habitat within this segment:

- Bald eagle
- Great gray owl
- Greater sandhill crane
- Loggerhead shrike
- Osprey
- Sage grouse
- Swainson's hawk
- Pallid bat
- Spotted bat
- American badger
- Pronghorn

Alternative 6

Under Alternative 6, transmission line segment A3 would replace segments A1 and A2, and segment C2 would replace segment C1. The affected environment for the power plant and wellfield area, and transmission line segment B1 would be the same under this alternative as described above for the proposed action. Existing conditions along segments A3, and C2 are described above under Alternatives 5 and 2, respectively. Table 3.8-3 summarizes special-status wildlife species presence and use of the alternatives.

Alternative 7 (No Action)

The setting for Alternative 7, the No Action alternative, would be the same as for the proposed project and the alternatives.

3.9 Visual Quality

DEFINITION OF STUDY AREA

The study area for the visual resource analysis of the proposed project includes the proposed power plant site, wellfield, and the proposed and alternative transmission line segments. In general, the study area encompasses those locations within the project vicinity where project components would potentially be visible. The study area includes vantage points in the Medicine Lake Highlands (including the Medicine Lake area), Lava Beds National Monument, and the general vicinity of the community of Tionesta.

METHODOLOGY

Field Evaluation and Data Collection

Field reconnaissance trips to study visual resources were conducted on the following dates:

- July 2 through July 5, 1996
- August 22 and August 23, 1996
- October 17 through October 19, 1996

Baseline information regarding Visual Quality Objectives (VQOs) was provided by the Modoc National Forest, Doublehead Ranger District, and the Klamath National Forest, Goosenest Ranger District. The baseline data were reviewed in sufficient detail to assess direct and indirect effects of the project. This analysis was conducted in compliance with the USFS Visual Management System (VMS) and updated to reflect the concepts of the USFS Scenery Management System (SMS). The terminology used in this analysis is consistent with that used in the VMS and SMS. Appendix D presents a glossary of terms commonly used in this section of the EIS/EIR.

Key Observation Points

The description of the existing visual setting is based on professional validation of existing conditions as seen from the Forest Road system and a series of Key Observation Points (KOPs) in the project region. Twenty-one KOPs were selected throughout the project study area as the basis for defining the existing visual setting and to facilitate the visual resource analysis for the project. The term "Key Observation Point" is a designator used in the field of visual resource assessment to identify view points of public significance within a given region. This term, however, is not a formal designation that is defined or regulated by Federal or state agencies.

KOPs were identified within the overall project region as a result of:

- Discussions with representatives of the National Park Service (NPS), Lava Beds National Monument, and the Modoc and Klamath National Forests
- Preliminary environmental work performed in the Fourmile Hill Exploration EA (BLM et. al. 1995)
- Travel routes of public visual sensitivity (Sensitivity Levels I and II) inventoried by the Modoc and Klamath National Forests
- The public scoping process conducted for this project

- Consultation with local American Indian tribes

These KOPs address views in the Medicine Lake Highlands, along identified sensitive travel routes, east of the Medicine Lake Highlands near Tionesta, and north of the Highlands in the Lava Beds National Monument. They provide a range of visual characteristics and views as seen in different landscape types and terrain and from various vantage points throughout the study area, and are located:

- Along major or significant travel route corridors (Primary Forest Routes 49, 77, and 97 and State Highway 139)
- Near residential areas (Tionesta and Medicine Lake)
- At existing recreation areas (Medicine Lake Recreation Management Area and Lava Bed National Monument)
- At major public view points (Timber Mountain, Lyons Peak, Little Mount Hoffman, and Schonchin Butte)

The range of KOP locations selected are intended to provide the full range of typical public views of the proposed action and associated visual impacts that may occur with project implementation. Table 3.9-1 identifies the view characteristics and orientation from each KOP. Figure 3.9-1 identifies the location of each KOP.

LANDSCAPE SETTING

Landscape Character / Scenic Attractiveness

The general project study area, including the lands traversed by the proposed and alternative transmission line corridors, can be viewed from Merrill, Oregon to the north, portions of the Butte Valley to the east, and Tionesta to the west. The majority of the project study area appears as a visually distinct volcanic mountain range set off from the surrounding level plateau and valley lands. The tallest and most visually prominent peak in the Mountain Range is Glass Mountain. Socially the area is known for its geologic interest, outdoor recreation opportunities, and Native American cultural values (see also Section 3.6, Cultural Resources). The general area is identified locally as the Medicine Lake Highlands.

The project region includes four imageable landscapes each with their own landscape character, degree of distinctiveness and integrity, and sense of place. These include the Medicine Lake Volcanic Caldera, the Glass Mountain/Medicine Lake Highlands, the Modoc Plateau, and the Tule Lake Valley, which are described below.

Medicine Lake Volcanic Caldera: The Medicine Lake Volcanic Caldera is a visually contained basin created by a ring of ridgelines and mountain tops that include: Mount Hoffman to the northeast; Glass Mountain to the east; Medicine Mountain to the south; and Little Mt. Hoffman, Badger Peak and Grouse Hill to the west (see Figure 2.2-2). The tree canopy within the caldera consists mostly of Lodgepole Pine and is soft-textured and fairly uniform in height. The forest of the Caldera is distinctively punctuated by the waters of Medicine Lake and Little Medicine Lake, the open flats of the Arnica sink, the treeless landscape of the Medicine Lake Lava Flow and a variety of small open meadow areas. Except for these natural anomalies, vegetation density prevents most on-the-ground views from extending beyond the immediate foreground.

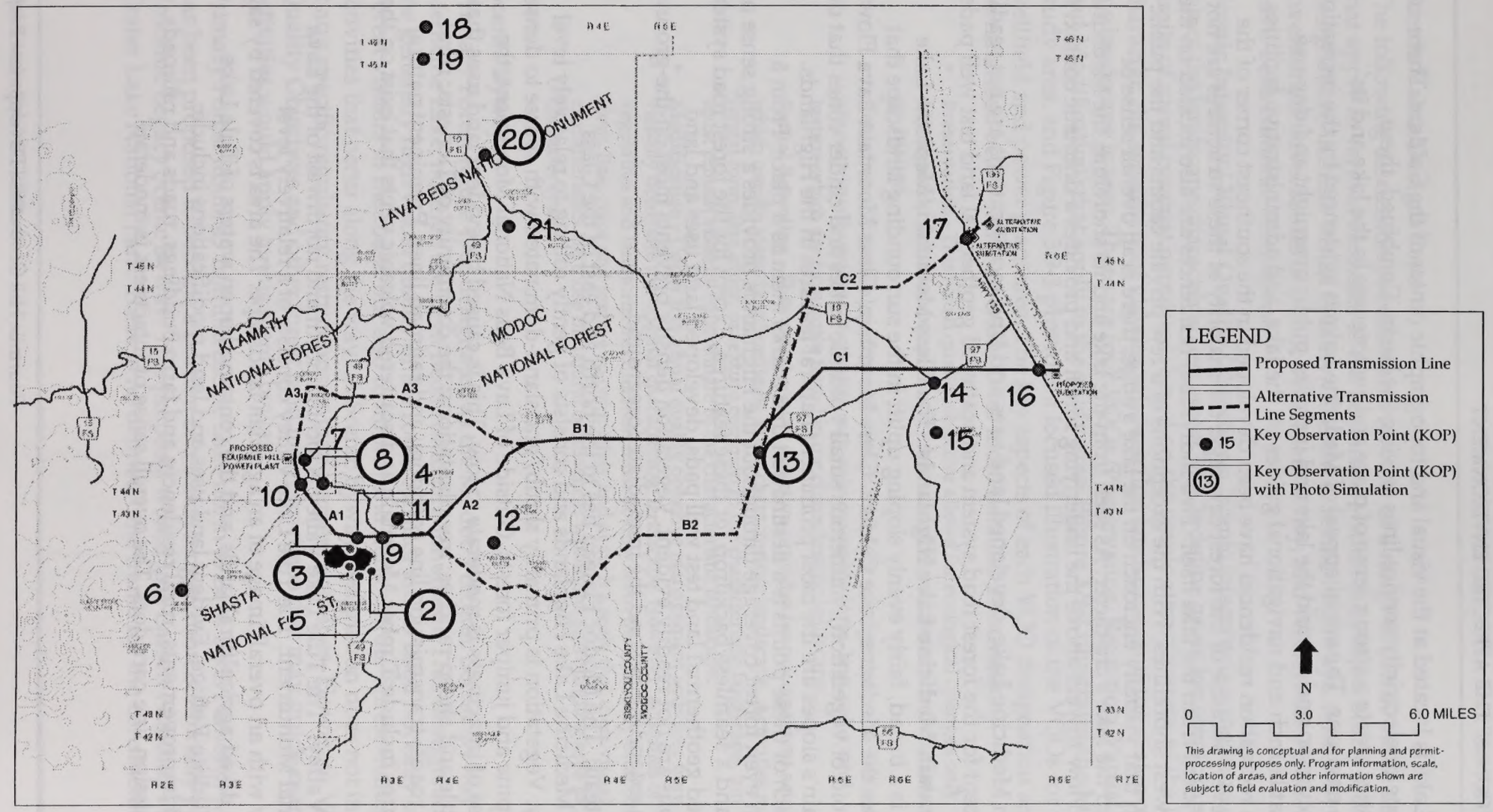
Table 3.9-1: Key Observation Points (see also Figure 3.9-1)

Map Key	Key Observation Point	View Characteristics and Direction[1]
1	Medicine Lake Recreation Area: A.H. Hogue Campground Shoreline, north shore of lake	Foreground and middleground views of lake and Medicine Mountain to the south.
2	Medicine Lake Recreation Area: Boat Launch on southeast shoreline	Foreground and middleground views of lake, lava flow, and rim of Caldera near Grouse Hill to northwest.
3	Medicine Lake Recreation Area: Medicine Lake on south side	Foreground and middleground views of lake and lava flow to the north.
4	Medicine Lake Recreation Area: Medicine Lake Lava Flow Trail	Foreground views of forest along trail corridor leading to lava flow.
5	Medicine Lake Recreation Area: Private recreation residence on southeast shoreline	Foreground and middleground views of lake, lava flow, and rim of Caldera near Grouse Hill to west and northwest.
6	Little Mount Hoffman Lookout on Shasta-Trinity National Forest	Panoramic views in all directions. Glass Mountain and Fourmile Hill are visible.
7	Primary Forest Route 49: Directly east of proposed power plant site	USFS inventoried travel route of public visual sensitivity. Foreground views to north and south along road way corridor. Views east and west are limited by forest cover along road.
8	Primary Forest Route 49: Vista point overlooking Medicine Lake	USFS inventoried travel route of public visual sensitivity. Middleground views overlooking Medicine Lake and Medicine Mountain to south and southeast.
9	Primary Forest Route 49: Crossing point of proposed transmission line	USFS inventoried travel route of public visual sensitivity. Foreground views to north and south along road. No middleground/ background views due to forest cover along road.
10	Primary Forest Route 77	USFS inventoried travel route of public visual sensitivity. Foreground views to east and west along road. No middleground/ background views due to forest cover along road.
11	Arnica Sink, North Side	Foreground and middleground views to south of Arnica Sink with backdrop for forest hills.
12	Forest Road 43N99 / Lyons Peak Loop Road	At vista pullout views to northwest towards Mt. Hoffman and overlooking Glass Mountain Lava Flow.
13	Primary Forest Route 97	USFS inventoried travel route of public visual sensitivity. Foreground, middleground and background views to west towards Medicine Lake Highlands. Eastern flank of Glass Mountain is visible.
14	Tionesta	Foreground views to north over Modoc Plateau. Views to west are limited by forest cover
15	Timber Mountain Fire Lookout	Panoramic views in all directions. Background view to west towards Medicine Lake Highlands. Eastern flank of Glass Mountain is visible.
16	State Highway 139: proposed transmission line route crossing (Segment C1)	USFS inventoried travel route of public visual sensitivity. Foreground views to east and west are limited by forest cover.
17	State Highway 139: alternative transmission line route crossing (Segment C2)	USFS inventoried travel route of public visual sensitivity. Views to east and west over Modoc Plateau in foreground. Medicine Lake Highlands visible in background.
18	Lava Beds National Monument: Gillem Camp	Views primarily to south and east over Modoc Plateau. Background views to south include northern flanks of Medicine Lake Highlands.
19	Lava Beds National Monument: Lava Beds National Monument Road Vista Point	Views primarily to south and east over Modoc Plateau. Background views to south include northern flanks of Medicine Lake Highlands.
20	Lava Beds National Monument: Schonchin Butte Lookout	Panoramic views in all directions. Background view to south towards Medicine Lake Highlands.
21	Lava Beds National Monument: Cave Loop Road	Orientation of views primarily to east and south over Modoc Plateau. Background views to south towards Medicine Lake Highlands are somewhat limited due to topography.

1 The descriptions of the visual characteristics in the directions indicated, are intended to provide visual settings in locations that could potentially be impacted by the proposed action (Alternative 1) or other alternatives.

SOURCE: 2M Associates and MHA Environmental Consulting, Inc.

Figure 3.9 -1: Key Observation Point (KOP) Locations



Medicine Lake is located at the visual and topographic center of the Caldera. There are no telephone or electricity service lines serving the basin. Combined, these characteristics create a strong sense of place and remoteness to the lake and its' immediate environs. The social appeal of Medicine Lake is evidenced by the recreation use that occurs on and around the lake and includes public overnight and day-use areas, a boat launch and navigational guides on the lake, and administrative facilities. Numerous recreation residences have been developed in the southeast corner of the lake. However, because of the forest coverage, the majority of these structures are not visually evident from the lake itself. Two individual residences are also located on the south and west shorelines. With the exceptions of a few private cabins and the public boat launch that visually encroach on the lake's edge, there is an overall sense of intactness to the lake's character. As seen from the lake and its shoreline, the Medicine Lake Lava Flow towers above the underlying forest and provides a dramatic context for the lake.

Away from Medicine Lake, developed land uses and land modifications are not readily evident except for the forest road system and scattered geothermal land test well pads.

Glass Mountain/Medicine Lake Highlands: The Glass Mountain/Medicine Lake Highlands is a broad, fairly evenly sloping uplift in the surrounding landscape that encompasses the Medicine Lake Caldera. Glass Mountain, Glass Mountain Lava Flow (which is void of vegetation), numerous small volcanic buttes and cinder cones that dot the mountain's slopes are the most prominent natural features in the Highlands. Visually, each of these points is a destination that marks them as a place. From a distance, an even forest coverage throughout the Highlands provides a strong sense of intactness and a seamless backdrop for these features. Except for the forest road system and scattered geothermal land test well pads, developed land uses and land modifications are not readily evident. Vegetation density prevents most on-the-ground views from extending beyond the immediate foreground.

Modoc Plateau: The Modoc Plateau lies to the north and east of the Glass Mountain/Medicine Lake Highlands and consists of gently rolling to relatively level topography. Vegetation is primarily shrub/grassland-dominated with sparse to dense ponderosa pine and juniper forests. Outside of Lava Beds National Monument, the overall sense of intactness is moderate to low. This is caused by evident land uses that include: cattle and sheep ranches; tree plantations; the community of Tionesta; rural residences; roads; transmission line corridors; and railroad lines. Prominent natural visual features include Timber Mountain and scattered volcanic vents that exist on the Plateau.

Tule Lake Valley: The Tule Lake Valley is located north and northwest of the Lava Beds National Monument. The Tule Lake Valley consists of a relatively level topography with an overall image of an agrarian landscape. The area is covered by sage grasslands, diked agricultural lands, and the contained open waters of Tule Lake National Wildlife Refuge. Evident land uses and land modifications include: agricultural improvements, rural residences and farm buildings, roads and railroads, and transmission line corridors. The overall sense of intactness is moderate.

Scenic Value Designations

The following discussion provides an overview of a range of scenic value designations that apply to various elements of the landscape within the project study area. These designations include Visual Quality Objectives, Scenic Highways, Scenic Byways, inventoried travel routes of public visual sensitivity, and Wilderness Areas within the Lava Beds National Monument.

Scenic Integrity / Visual Quality Objectives: Scenic integrity is a measure of how intact the landscape character is perceived. VQOs define goals for scenic integrity and limits of visual contrast permitted, based on the scenic attractiveness of the landscape character, the sensitivity of viewers who see that landscape, and the distance at which the landscape is seen. There are four VQOs (Preservation, Retention, Partial Retention, and Modification) that apply to the study area. Figure 3.9-2 illustrates the VQOs in the study area, and Figure 3.9-3 provides a focused illustration of the VQOs for the wellfield and power plant area. The key aspects of each VQO designation are summarized below (see Appendix D for more detailed information).

- **Preservation** - This visual quality objective allows for ecological changes only. Management activities except for very low visual impact recreation facilities are prohibited.
- **Retention** - This visual quality objective provides for management activities which are not visually evident. Activities may only repeat the form, line, color, and texture which are frequently found in the characteristic landscape.
- **Partial Retention** - This visual quality objective provides for management activities which remain visually subordinate to the characteristic landscape. Activities may repeat form, line, color, or texture common to the characteristic landscape, but must remain visually subordinate to the characteristic landscape.
- **Modification** - Under this visual quality objective management activities may visually dominate the original characteristic landscape. However, activities of vegetative and landform modification must borrow from the naturally established form, line, color and texture so completely and at such a scale that their visual characteristics are those of natural occurrences within the surrounding area or character type.

Scenic Byways

Primary Forest Route 49 is designated as the Modoc Volcanic Scenic Byway from Medicine Lake, north to the Lava Beds National Monument. This designation reflects the generally high visual quality of the route corridor and is used not only to attract Forest visitors to the route, but also to inform and demonstrate Forest management activities that occur along the way. A Scenic Byway designation does not include with it any specific regulatory restrictions or management activities. However, Visual Quality Objectives and other forest land use restrictions that may guide management activities would apply to this scenic byway.

Primary Forest Route 49 from Medicine Lake north to Lava Beds National Monument has been proposed to become a portion of a much longer, more nationally prominent Volcanic Legacy Scenic Byway. This proposal would link Lassen National Park with Crater Lake National Park. There is no defined time frame for the consideration of this

Figure 3.9-2: VQO Designations Along Alternative Transmission Line Routes

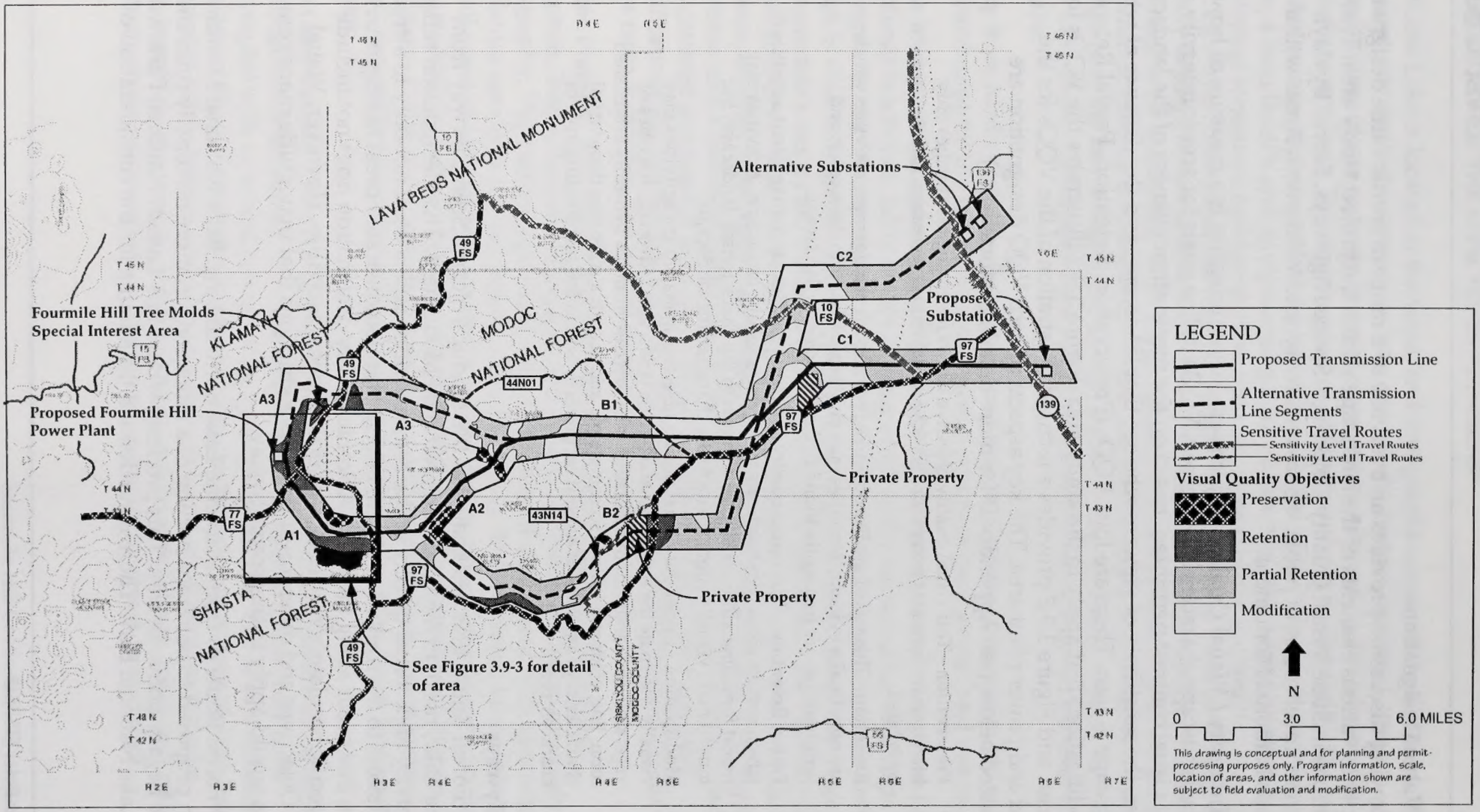
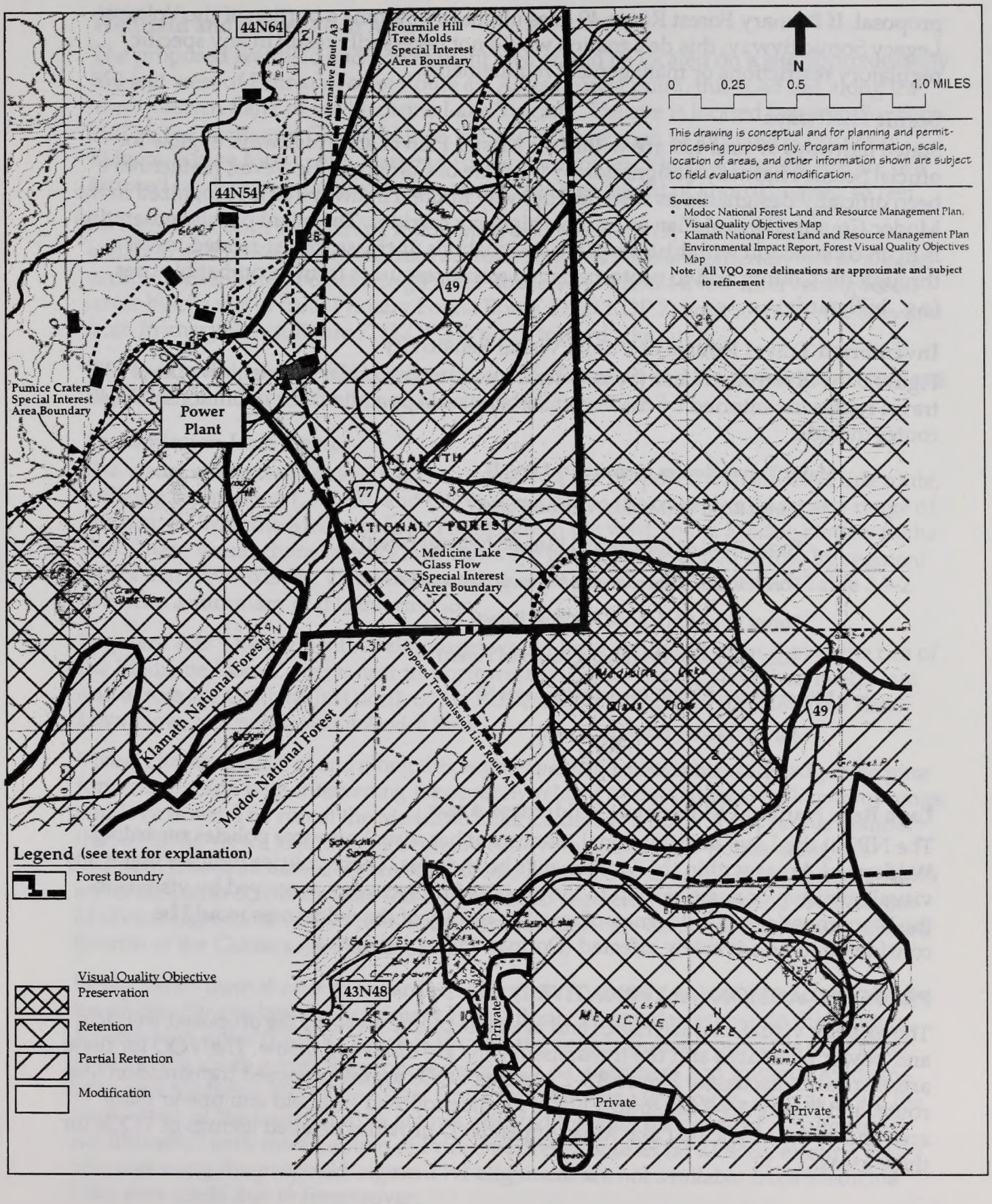


Figure 3.9-3: VQO Designations for the Proposed Wellfield and Power Plant Area



proposal. If Primary Forest Route 49 does ultimately become a portion of the Volcanic Legacy Scenic Byway, this designation would not necessarily result in any specific regulatory restrictions or management requirements.

Scenic Highways

State Highways 97 and 139 are within the Master Plan of state highways eligible for official Scenic Highway designation by the State of California. However, neither have been officially designated as a Scenic Highway Route. Highway 139 is recognized in the Modoc County General Plan as a scenic highway corridor. The intent of this recognition is to, in conjunction with historic place designations, increase tourist-related travel through the County and to protect existing scenic resources from incompatible uses (e.g., billboards).

Inventoried Travel Routes of Public Visual Sensitivity

Figure 3.9-1 illustrates major (Sensitivity Level I) and secondary (Sensitivity Level II) travel routes inventoried by the Forest Service (see Appendix D for definitions). These routes include:

- **Major Travel Routes (Sensitivity Level I)**

  Forest Road 10 (Modoc National Forest)

  Forest Road 49 (Modoc and Klamath National Forest)

  Forest Road 77 (Modoc and Klamath National Forest)

  Forest Road 97 (Modoc National Forest)

  State Highway 139 (Modoc National Forest)

- **Minor Travel Routes (Sensitivity Level II)**

  44N01 (Modoc National Forest)

  43N13 (Modoc National Forest)

Lava Beds National Monument Wilderness Areas

The NPS at the Lava Beds National Monument has visual resource policies regarding Wilderness Areas within the Monument's boundaries. These policies indicate that if any visual intrusion or noise related to the proposed project were perceived by visitors in the Monument's two Wilderness Areas, the quality of the wilderness would be considered to be adversely affected (Dorman 1996, pers. com.).

PROPOSED ACTION (ALTERNATIVE 1)

The existing visual characteristics and available public views of the proposed wellfield and power plant area and the transmission line are discussed below. The VQO for these areas are also discussed. Figure 3.9-2 presents VQOs for the proposed transmission line route, and Figure 3.9-3 illustrates VQOs for the proposed wellfield and power plant area and in the Medicine Lake Area. Appendix D provides detailed listings of VQOs for these areas.

Wellfield and Power Plant Area

The proposed wellfield and power plant area would be located on a site approximately 850 feet west of Primary Forest Route 49. At its nearest point, this road lies along the northwestern flank of the Medicine Lake Volcano. The site is located between Fourmile Hill on the north and Grouse Hill on the south. Vegetation in this area is primarily lodgepole pine forest, with scattered rock outcroppings. Views across the site are of a forested landscape generally having an average tree height of approximately 45 feet.

As a result of both intervening topography and forest cover, existing views into the wellfield and power plant site from surrounding locations are generally not available, except from selected points along Forest Roads 44N54 and 44N64. Intervening forest cover blocks views from Primary Forest Route 49 (at KOP 7) west towards the site, and from Primary Forest Route 77 (KOP 10) north towards the site.

The wellfield site has a VQO designation of Modification and the power plant site has a VQO designation of Retention, as illustrated in Figure 3.9-3.

Transmission Line Route

The visual characteristics and views to and along the proposed transmission line route, utilizing segments A1, A2, B1, and C1, vary widely as the route would cross a range of landscapes from the Medicine Lake Highlands in the west, to the Modoc Plateau in the east. These visual characteristics and views are generally described below by segment. KOPs that have existing views into or along segments are also identified. Table 3.9-2 provides a summary of this information.

Segment A1: The segment A1 alignment would head southeast up and over the rim of the Medicine Lake Caldera, near its northwestern flank. The segment then heads east and across the Caldera, just north of Medicine Lake and south of the Medicine Lake Lava Flow, to a point east of Arnica Sink.

Visual characteristics of and along this segment are of a predominately lodgepole pine forest landscape with intervening topography related to the Caldera, rock outcroppings, and lava flows. The rim of the Medicine Lake Caldera is a major topographic feature that confines views to and along segment A1. From public view points along the southern and southeastern shore of Medicine Lake (KOPs 2, 3, and 5), panoramic views are to the north across the lake and the proposed segment A1 alignment, towards the Medicine Lake Lava Flow. Views from these locations are also to the northwest toward the rim of the Caldera near Grouse Hill.

Public views from the north towards the segment A1 alignment and Medicine Lake are intermittently available from Primary Forest Route 49 as it descends into the Caldera. An overlook point (KOP 8), which is located at a vehicle pullout, provides panoramic views to the south across the proposed segment A1 alignment and towards Medicine Lake and Medicine Mountain. Other south facing public viewpoints, such as along the north shore of the Lake (KOP 1), are not oriented towards the segment A1 alignment. Additionally, with the exception of Primary Forest Route 49 (at KOP 8), existing views into and along the proposed segment A1 alignment are not available from Medicine Lake area roads due to forest cover.

Table 3.9-2 Existing Landscape Character and Views by Transmission Line Segment[1]

Segment[2]	Landscape Character Attributes	Extent and Integrity of Existing Views Across Segment Alignments from KOPs
A1 Alt. 1	Lodgepole pine, rock outcroppings, and lava flows. Medicine Lake Caldera defines visual characteristics along segment, including view distance and features, such as Medicine Lake.	Foreground/middleground views across segment alignment from KOPs 2, 3, 5, and 6. Foreground views from KOPs 4, 8, and 11. Existing Scenic Integrity is high dominated by an even forest cover that visually absorbs management activities.
A2 Alt. 1	Lodge pole pine forest, steep terrain, and lava flow. Alignment passes over the edge of the Medicine Lake Caldera, between Mt. Hoffman and Glass Mountain.	Middleground views across portion of segment from Lyons Peak Loop Road (KOP 12). Background and distant views of north side of Medicine Lake Highlands from Schonchin Butte (KOP 20). Existing Scenic Integrity is high in most locations and moderate in selected areas due to existing wellfield development related to geothermal testing and access roads.
A3	Lodgepole pine landscape and rock outcroppings. Alignment crosses the northern flank of Medicine Lake Caldera west of Fourmile Hill, and then turns east towards Glass Mountain. Topographical features on by northern side of Medicine Lake Highlands characterized by even slopes punctuated by cinder cones and volcanic buttes.	Not seen from Primary Forest Route 49 (KOP 7) due to forest cover. Crosses Primary Forest Route 49, FR44N54 and FR44N64. Portion of segment passing north of Fourmile Hill, may be visible from Schonchin Butte (KOP 20). Background views available from Primary Forest Route 10 and Lava Beds National Monument (KOPs 18-21). Existing Scenic Integrity is high dominated by an even forest cover.
B1 Alt. 1	Mixed-conifer landscape transitioning to ponderosa pine and juniper forest and shrub/grassland vegetation as alignment comes down the northeastern side of Glass Mountain into the Modoc Plateau.	Foreground views from the east (KOPs 13 and 16). Background views from the north from Primary Forest Route 10 and Lava Beds National Monument (KOPs 18-21). Existing Scenic Integrity is high.
B2	Mixed-conifer forest as alignment passes along southern side of Medicine Lake Highlands. Then transition to ponderosa pine and juniper forests and shrub/grassland vegetation as alignment moves into the Modoc Plateau.	Foreground views of Primary Forest Route 97 (KOP 13). Background view from Timber Mountain (KOP 15). Existing Scenic Integrity is high except along existing transmission line where it is low.
C1 Alt. 1	Flat landscape, shrub/grassland vegetation with moderately dense to sparse ponderosa pine and juniper forest cover as alignment moves into the Modoc Plateau.	Foreground and background views from KOPs 13-16. Views from Primary Forest Route 10 and other northern locations. Existing Scenic Integrity is moderate to low due to rural residences and other development, numerous roads, railroad tracks, and existing transmission lines that are scattered throughout the otherwise undisturbed landscape.
C2	Flat landscape, shrub/grassland vegetation as alignment moves into the Modoc Plateau with sparse ponderosa pine and juniper forest cover to west.	Foreground and background views from KOPs 15 and 17 and other northern locations. Integrity is moderate to low due to ranch development, roads, railroad tracks and existing transmission lines that dominate the otherwise undisturbed landscape around State Highway 139 (KOP 17).

Notes:

1 The description of existing views from KOPs is intended to provide an overview of the nature of existing views that exist in proximity to the proposed segment alignments. It is not intended to be an evaluation of the visibility of the proposed transmission line from KOPs.

2 This column includes alternative segments.

Alt. 2 = A1, A2, B1, C2
Alt. 3 = A1, B2, C1
Alt. 4 = A1, B2, C2
Alt. 5 = A3, B1, C1
Alt. 6 = A3, B1, C2

SOURCE: MHA Environmental Consulting, Inc. and 2M Associates

VQOs along the segment A1 alignment are a combination of Retention, Partial Retention, and Modification, as illustrated in Figure 3.9-2.

Segment A2: The segment A2 alignment heads northeast and passes between Mt. Hoffman on the west and Glass Mountain on the east. Visual characteristics along this segment are of a mixed-forest landscape with the major topographical features related to these two mountains and the Glass Mountain Lava Flow. The presence of these mountains, one on either side of the proposed segment A2 alignment, confines views to and along this segment. Public view points along this segment are available from the Lyons Peak Loop Road (KOP 12), which overlooks Glass Mountain and the Glass Mountain Lava Flow.

Public views along forest roads from the north towards the segment A2 alignment are generally not available due to forest cover along these roads. Background views of the northern side of the Medicine Lake Highlands (including Mt. Hoffman and Glass Mountain) are available from other northern locations, including the Lava Beds National Monument. It is likely that portions of the segment A2 alignment are visible from some locations within the National Monument, such as Schonchin Butte (KOP #20) and other cinder cones and volcanic buttes. Likewise, this segment alignment (if visible) would be seen as part of the larger panoramic views of the Medicine Lake Highlands that are available from distant northern locations.

VQOs along the segment A2 alignment are a combination of Preservation, Partial Retention, and Modification, as illustrated in Figure 3.9-2.

Segment B1: The segment B1 alignment would head east from the Medicine Lake Highlands onto the Modoc Plateau. The characteristic landscape along this segment is a mixed-forest landscape transitioning to ponderosa pine and juniper forests as the alignment comes down the northeastern side of Glass Mountain. The Modoc Plateau, along the central and eastern portions of this segment alignment, is relatively flat and composed of forested and low-lying shrub/grassland vegetation. The segment B1 alignment and surrounding lands are visible from a variety of public viewing points east of this segment alignment, including State Highway 139 (KOP 16), Primary Forest Route 97 (KOP 13), and Timber Mountain (KOP 15).

Public views along Primary Forest Road 10 from the north towards the segment B1 alignment are also available as the shrub/grassland vegetation that occurs along this road does not block long-range views. Distant background views of the northern side of the Medicine Lake Highlands (including Mt. Hoffman and Glass Mountain) and the Modoc Plateau are available from other northern locations, including the Lava Beds National Monument. It is likely that portions of the segment B1 alignment are visible from a range of locations within the National Monument (KOPs 18-21).

VQOs along the segment B1 alignment are a combination of Partial Retention and Modification, as illustrated in Figure 3.9-2.

Segment C1: The segment C1 alignment would head northeast and then east towards State Highway 139, passing just north of the community of Tionesta and Timber Mountain. As for much of segment B1, segment C2 is characterized by the flat landscape of the Modoc Plateau. Visual characteristics of and along this segment are

fairly uniform and are dominated by the low-lying shrub/grassland vegetation that covers the Plateau. As a result of this relatively level landscape, the segment C1 alignment and surrounding lands are visible from a variety of public viewing points which surround this segment alignment, including State Highway 139 (KOP 16), Primary Forest Route 97 (KOPs 13 and 14), and Timber Mountain (KOP 15).

Public views along Primary Forest Road 10 from the north towards the segment C1 alignment are also available but filtered by scattered forest trees and topography that occur along this road. Long-range views of the Modoc Plateau are available from other northern locations, including the Lava Beds National Monument. However, due to the flat nature of the topography and the distance, it is likely that views of the segment C1 alignment are obscured from distant northern locations.

VQOs along the segment C1 alignment are a combination of Partial Retention and Modification, as illustrated in Figure 3.9-2.

ALTERNATIVES

Introduction

This section describes the visual setting of each alternative to the proposed action. For Alternatives 2 through 6, the affected environment for the proposed wellfield and power plant would be the same as described for the proposed action since these elements would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of the setting along these portions of the route would not be repeated under each alternative discussion. The description of the affected environment focuses on the segments of the transmission line that would be different from those described for the proposed action.

The existing visual characteristics and available public views of the transmission line routes under each alternative are discussed below. The VQOs for each alternative are also provided. Figure 3.9-3 presents VQOs for the proposed wellfield and power plant area. Figure 3.9-2 presents VQOs for the alternative transmission line routes. Appendix D provides detailed listings of VQOs for these areas.

Alternative 2 (Segments A1, A2, B1, C2)

Wellfield and Power Plant Area: The existing visual characteristics and views at the proposed wellfield and power plant area are the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area, under this alternative, would occur on the same site as identified for the proposed action.

Transmission Line Route: The transmission line route under Alternative 2 would utilize segments A1, A2, B1, and C2. Visual characteristics and views to and along transmission line route segments A1, A2, and B1 are the same under Alternative 2 as described above for the proposed action (Alternative 1). Existing visual characteristics and views to and along the segment C2 alignment are described below (see also Table 3.9-2).

Segment C2: Similar to segment C1, the segment C2 alignment would head northeast towards State Highway 139, but it would pass further to the north through the Dry Lake area. Segment C2 is characterized by the relatively flat landscape of the Modoc

Plateau. Visual characteristics of and along this segment are fairly uniform and are dominated by the low-lying shrub/grassland vegetation that covers the Plateau. As a result of this level topography, the segment C2 alignment and surrounding lands are visible from a variety of public viewing points, including State Highway 139 (KOP 17) and Timber Mountain (KOP 15).

Public views along Primary Forest Road 10 towards the segment C2 alignment are also available where the alignment would cross the road and elsewhere as the shrub/grassland vegetation and scattered forest trees that occur along this road do not block distant background views. Background views are available from other northern locations, including the Lava Beds National Monument. However, as for segment C1, views of the C2 segment alignment are somewhat obscured from distant northern locations, due to the flat nature of the topography.

VQOs along the segment C2 alignment are a combination of Partial Retention and Modification, as illustrated in Figure 3.9-2.

Alternative 3 (Segments A1, B2, C1)

Wellfield and Power Plant Area: The existing visual characteristics and views at the proposed wellfield and power plant area are the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area, under this alternative, would occur on the same site as identified for the proposed action.

Transmission Line Route: The transmission line route under Alternative 3 would utilize segments A1, B2, and C1. Visual characteristics and views to and along transmission line route segments A1 and C1 are the same under Alternative 3 as described above for the proposed action (Alternative 1). Existing visual characteristics and views to and along the segment B2 alignment are described below (see also Table 3.9-2).

Segment B2: The segment B2 alignment would head southeast and then east along the southern side of the Medicine Lake Highlands onto the Modoc Plateau. The characteristic landscape along this segment is of a mixed-forest landscape transitioning to ponderosa pine and juniper forests as the alignment comes down the southeastern side of Glass Mountain. The Modoc Plateau, along the central and eastern portions of this segment alignment, is relatively flat. The eastern portion of the segment B2 alignment and surrounding lands are visible from a variety of public viewing points east and north of this segment alignment, including Primary Forest Route 97 (KOP 13) and Timber Mountain (KOP 15). In the higher elevations along the western portions of this segment alignment, forest tree cover along Primary Forest Route 97 blocks surrounding views. A portion of this segment alignment may also be visible when looking south from the Lyons Peak Loop Road overlook (KOP 12).

Background views of the segment B2 alignment from locations further north, including the Lava Beds National Monument are generally not available as the Medicine Lake Highlands block such views.

VQOs along segment B2 are Retention, Partial Retention, and Modification (see Figure 3.9-2).

Alternative 4 (Segments A1, B2, C2)

Wellfield and Power Plant Area: The existing visual characteristics and views at the proposed wellfield and power plant area are the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area, under this alternative, would occur on the same site as identified for the proposed action.

Transmission Line Route: The transmission line route under Alternative 4 would utilize segments A1, B2, and C2. Visual characteristics and views to and along transmission line route segment A1 are the same under Alternative 4 as described above for the proposed action (Alternative 1). Existing visual characteristics along the segment B2 alignment are the same as described above for Alternative 3. Existing visual characteristics along the segment C2 alignment are the same as described above for Alternative 2.

Alternative 5 (Segments A3, B1, C1)

Wellfield and Power Plant Area: The existing visual characteristics and views at the proposed wellfield and power plant area are the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area, under this alternative, would occur on the same site as identified for the proposed action.

Transmission Line Route: The transmission line route under Alternative 5 would utilize segments A3, B1, and C1. Visual characteristics and views to and along transmission line route segments B1 and C1 are the same under Alternative 5 as described above for the proposed action (Alternative 1). Existing visual characteristics and views to and along the segment A3 alignment are described below (see also Table 3.9-2).

Segment A3: The segment A3 alignment would head northeast from the power plant, down the northern flank of the Medicine Lake Caldera, and would pass west of Fourmile Hill. The segment turns southeast and passes between Fourmile Hill on the south and Lookout Butte on the north. Segment A3 would then head east and southeast to a point just south of Indian Butte, cutting across the northern side of the Medicine Lake Highlands, and passing along the north side of Mt. Hoffman.

Along the portion of the segment in the Fourmile Hill area, the characteristic landscape is of a predominantly Lodgepole pine landscape with intervening topography and scattered rock outcroppings. Views into and along this segment are not available from Primary Forest Route 49 (KOP 7) due to forest cover along this road. This segment alignment is visible in the foreground where the alignment crosses Forest Roads 44N54 and 44N64. Distant background views of the northern side of the Medicine Lake Highlands, including the north side of Fourmile Hill are available from other northern locations, including, Schonchin Butte (KOP 20).

The characteristic landscape along the eastern portion of the segment is of a predominantly lodgepole pine landscape with topography related to Mt. Hoffman and a variety of cinder cones and volcanic buttes that occur in this area. From the south, there are no easily accessible public view points that provide existing views into and along this segment alignment as the Medicine Lake Highlands block views from southern locals.

Views along Primary Forest Road 10 from the north towards the segment A3 alignment are probably available due to the shrub/grassland vegetation that occurs along this road. Distant background views of the northern side of the Medicine Lake Highlands, including Mt. Hoffman and Glass Mountain are available from other northern locations, including the Lava Beds National Monument. It is likely that portions of the segment A3 alignment are visible from a range of locations within the National Monument including KOPs 18-21 and other cinder cones and volcanic buttes.

VQOs along the segment A3 alignment are a combination of Retention, Partial Retention, and Modification, as illustrated in Figure 3.9-2.

Alternative 6 (Segments A3, B1, C2)

Wellfield and Power Plant Area: The existing visual characteristics and views at the proposed wellfield and power plant area are the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area, under this alternative, would occur on the same site as identified for the proposed action.

Transmission Line Route: The transmission line route under Alternative 6 would utilize segments A3, B1, and C2. Visual characteristics and views to and along transmission line route segment B1 are the same under Alternative 6 as described above for the proposed action (Alternative 1). Existing visual characteristics along segment A3 are the same as described above for Alternative 5. Existing visual characteristics along segment C2 are the same as described above for Alternative 2.

Alternative 7 (No Action)

The setting for Alternative 7, the No Action alternative, would be the same as for the proposed project and alternatives.

3.10 Plans and Policies

DEFINITION OF STUDY AREA

The proposed project would be located on the Klamath and Modoc National Forests within Siskiyou and Modoc Counties, California. All planning and policy documents for the general project area were considered in this analysis.

METHODOLOGY

Plans and policies were reviewed for their applicability to the proposed project. Since the proposed project is entirely located on National Forest lands (which are under the jurisdiction of the USFS), USFS planning documents were reviewed. These documents include:

- Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl, also known as the Northwest Forest Plan (USFS and BLM 1994a) and associated EIS (USFS and BLM 1994b)
- Klamath National Forest Land and Resource Management Plan (USFS 1995) and associated EIS (USFS 1995)
- Modoc National Forest Land and Resource Management Plan (USFS 1991a) and associated EIS (USFS 1991b)

In addition, BLM Alturas Resource Area Resource Management Plan (BLM 1983) and the lease stipulations for Calpine's Federal geothermal leases (BLM 1988) were reviewed for applicable conditions. A review of the Siskiyou and Modoc County General Plans was also conducted to identify applicable plans and policies in these documents; however, since the proposed project is located entirely on Federal lands, these plans have limited applicability to the proposed project.

PROPOSED ACTION (ALTERNATIVE 1)

Applicable plans and policies are also contained in policy documents such as the Water Quality Control Plan for the North Coast Region (NCRWQCB 1994) and the Geothermal Resource Operational Orders. The plans and policies in these documents are discussed in the appropriate sections of this chapter (3.3, Hydrology, 3.14, Noise, and 3.13, Air Quality). The following summarizes applicable plans and policies from the USFS planning documents, the Federal geothermal leases, and the Siskiyou and Modoc County General Plans. The Northwest Forest Plan is discussed first because the policies outlined in this document have been incorporated into both the Klamath National Forest and Modoc National Forest LRMPs.

The Northwest Forest Plan

The Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the northern spotted owl (also known as the Northwest Forest Plan) and the accompanying EIS were adopted by the USFS and BLM in 1994 (USFS and BLM 1994a; USFS and BLM 1994b). The intent of this plan is to protect and enhance old-growth and late-successional forest ecosystems in Washington, Oregon, and Northern California. The Northwest Forest Plan is primarily focused on managing timber harvest programs.

The Record of Decision for the Northwest Forest Plan officially amended all approved LRMPs for National Forests located within the range of the northern spotted owl to ensure consistency between plans. The Modoc National Forest LRMP was adopted in 1991 and amended by the Northwest Forest Plan. The Klamath National Forest LRMP was approved in 1995 subsequent to the adoption of the Northwest Forest Plan, and the management policies of the Northwest Forest Plan have been incorporated into the Klamath National Forest LRMP.

The Northwest Forest Plan divides the range of the northern spotted owl into seven land management categories:

- Congressionally Reserved Areas
- Late-Successional Reserves
- Adaptive Management Areas
- Managed Late-Successional Areas
- Administratively Withdrawn Areas
- Riparian Reserves
- Matrix (includes those Federal lands not designated as one of the other six categories)

The plan outlines tailored management standards and guidelines for each land category. Riparian Reserves occur within other land management areas, such as Managed-Late Successional Areas or Matrix. The Northwest Forest Plan identifies additional standards and guidelines that apply to Riparian Reserves. The plan also identifies "Key Watershed" areas and specifies additional standards and guidelines for these watersheds.

The proposed power plant site and a portion of the transmission line corridor would be located at the extreme eastern edge of the designated range of the northern spotted owl in California (as delineated in the Northwest Forest Plan). The proposed project facilities would be located on the edge of the "CA Cascade" physiographic province. The power plant and wellfield and the portion of the transmission line within the Klamath National Forest are located on lands designated as the Goosenest Adaptive Management Area (AMA). Within the Klamath National Forest, the project would not cross or be adjacent to any perennial or intermittent surface waters, and therefore would not be located within any Riparian Reserves. The portions of the transmission line located on the Modoc National Forest and within the range of the northern spotted owl are on lands designated as either Matrix and/or Riparian Reserves. The project area is not located within a Key Watershed.

Klamath National Forest Land and Resource Management Plan

The power plant and wellfield area and a portion of the proposed transmission line would be located on the Klamath National Forest. The Klamath National Forest Land and Resource Management Plan (LRMP) and the accompanying EIS were adopted by the USFS in 1995 to establish management practices, standards, and guidelines for Klamath National Forest lands. The purpose of the LRMP is to provide for multiple use and the sustained yield of goods and services from the Forest in a manner that maximizes long-term net public benefits in an environmentally sound manner.

The LRMP divides the forest lands into several types of land management areas. Management priorities vary for each type of area and additional management standards may apply. The proposed power plant and wellfield area would be located near the eastern boundary of the Klamath National Forest. The project would be within or adjacent to the following types of land management areas:

- General Forest Management Area — These lands support a variety of vegetation, including shrubs, hardwoods, and softwoods. Timber output and habitat structural features are high management priorities in these areas.
- Retention Visual Quality Objectives (VQOs) Management Area — These are areas designated as having a "Retention" VQO (see Section 3.9, Visual). They are managed to maintain a natural or natural-appearing landscape and to minimize human impacts on this visual landscape.
- Partial Retention Visual Quality Objectives (VQOs) Management Area — These are areas designated as having a "Partial Retention" VQO (see Section 3.9, Visual). Similar to Retention Management Areas, they are managed to minimize human impacts on the natural visual landscape.
- Special Interest Areas — These areas are managed to protect their ecological processes and unique features, and to promote public use, education, and interpretation of the special interest values of the areas.

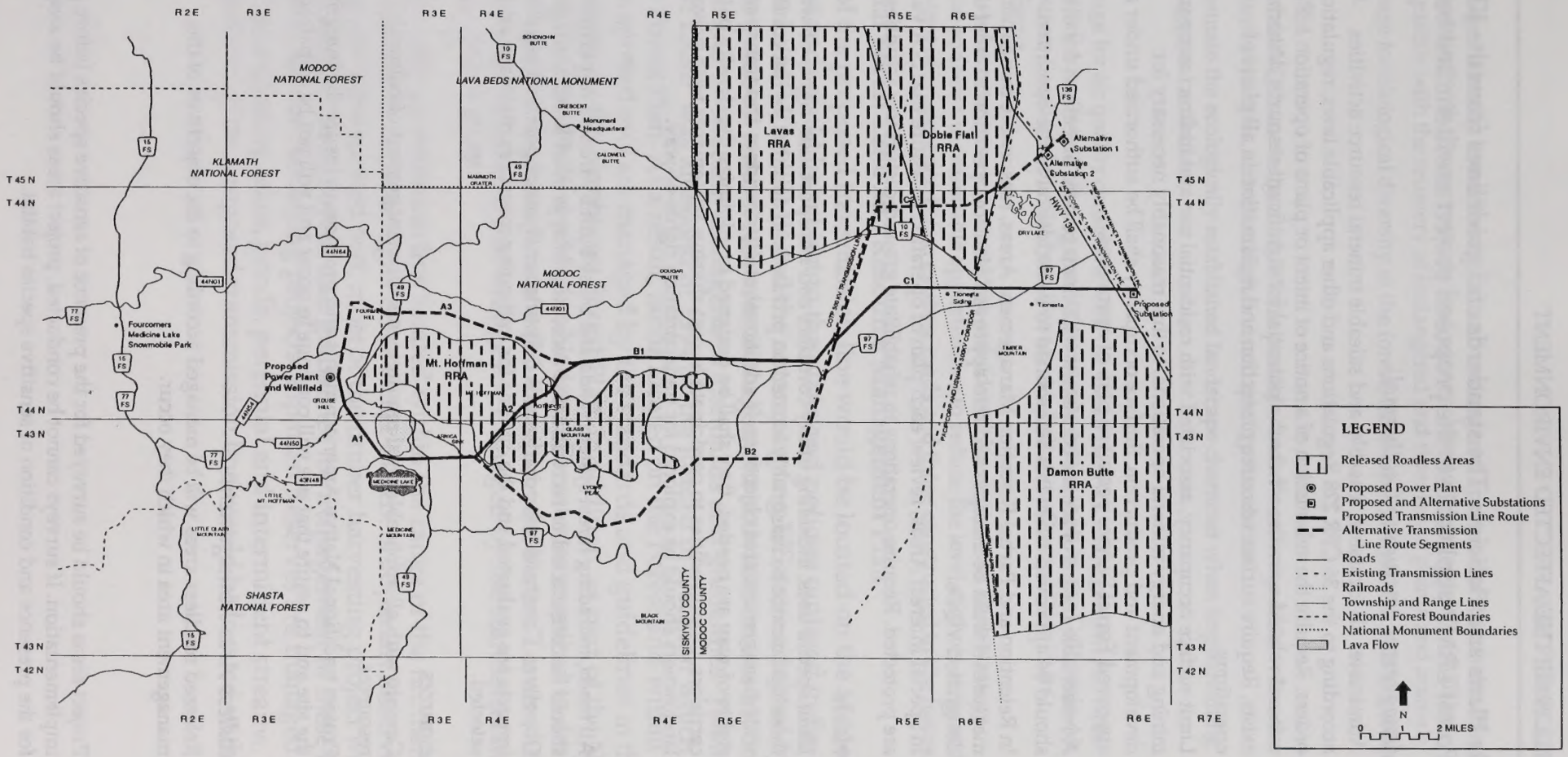
The proposed power plant and wellfield area would also be located within the Goosenest Adaptive Management Area (AMA), as designated in the Northwest Forest Plan. AMAs are landscape units designated to encourage the development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives. In 1996, the USFS performed an Ecosystem Analysis of the Goosenest AMA (USFS 1996) as part of the LRMP implementation analysis. The Goosenest Adaptive Management Area Ecosystem Analysis is based on the plans and policies of the Klamath National Forest LRMP and does not contain any additional plans or policies applicable to the proposed project.

The EIS prepared for the Klamath National Forest LRMP also analyzed "released roadless areas" located on the Forest, which are areas that were previously under consideration to be designated as Wilderness. These areas have been "released" from consideration as Wilderness and are intended to be managed according to the objectives of the management area in which they occur. The following describes analysis policies related to released roadless areas on all Forests.

Released Roadless Areas: As shown in Figure 3.10-1, a small portion (500 acres of 11,300 total) of the Mount Hoffman released roadless area lies within the Klamath National Forest. The proposed transmission line would cross the Modoc National Forest portion of the Mount Hoffman released roadless area.

Section 20.6.3 of the USFS *Environmental Policy and Procedures Handbook* (USFS 1992) states that proposals that would substantially alter the undeveloped character of an inventoried roadless area of 5,000 acres or more require the preparation of an Environmental Impact Statement (EIS). Section 20.6.3(a) of the Handbook identifies the construction of roads and harvesting timber that would affect approximately 5% of a roadless area in only one part of the roadless area as an example of such a proposal.

Figure 3.10-1: Released Roadless Areas in the Project Vicinity



MHA *Environmental Consulting, Inc.*

SOURCE: USFS

Applicable Plans and Policies: The standards and guidelines from the Klamath National Forest LRMP applicable to the proposed project are identified below.

Minerals Management (including Geothermal)

- Administer all locatable, leasable, and saleable mineral resource activities according to the 36 CFR 228 Regulations and other applicable laws, regulations and orders. Require the submission of a notice of intent or plans of operation for all mineral-related activities where the potential for significant resource disturbance exists. Require surface resource protection and reclamation in all plans of operations.
- Limit surface occupancy, associated with residential use and indirect support for mining and energy mineral operations, to that reasonably necessary for development and production. Surface occupancy shall be authorized under an approved Forest Service permit or plan of operations.
- A reasonable means of access, consistent with management objectives for the area, should be approved when it is determined to be incidental to the operation.
- In Retention and Partial Retention Management Areas, reasonable mitigation measures should be incorporated into approved plans of operation to meet the designated VQOs.
- In Special Interest Areas, review each plan of operation to assure that SIA values are protected. Require operations to rehabilitate ground-disturbing activities.

Utility Corridors

- Limit special uses, including utility corridors and transportation rights-of-way, to those that cannot be reasonably located on private land and that do not conflict with management area objectives. If additional utility corridors and transportation rights-of-way are needed, they shall be designed to minimize the density of these corridors. Opportunities to participate in cost-sharing agreements with private landowners should be explored for transportation rights-of-way.

Roads

- All roads, including forest system roads and those built by miners or permittees, should be constructed or reconstructed according to approved Road Management Objectives. Construct temporary roads only after analysis of potential resource impacts are evaluated and the options for mitigating measures disclosed and selected.

Cultural Resources

- Comply with all applicable legal requirements for management of cultural resources.
- Protect traditional Native American rights and practices to insure the integrity of the site and to assure that use will continue to occur and will not be impaired.

Released Roadless Area Management

- Released roadless areas will be managed according to the objectives of the management area in which they occur.

Biology

- Project areas should be surveyed for the presence of sensitive species before project implementation. If surveys cannot be conducted, project areas should be assessed for the presence and condition of sensitive species habitat.

- Manage Federally listed threatened and endangered species and their habitat in cooperation with the appropriate lead agency. Management activities shall be compatible with the recovery of endangered and threatened plants and animals.
- Manage for biological diversity at the forest, landscape/watershed, and site (stand) level.

Visual Resources

- Maintain VQOs as designated. Where possible, and where compatible with other resource objectives, strive for higher visual quality standards.
- Perpetuate the ecologically established landscape character when implementing management activities.

Air Quality

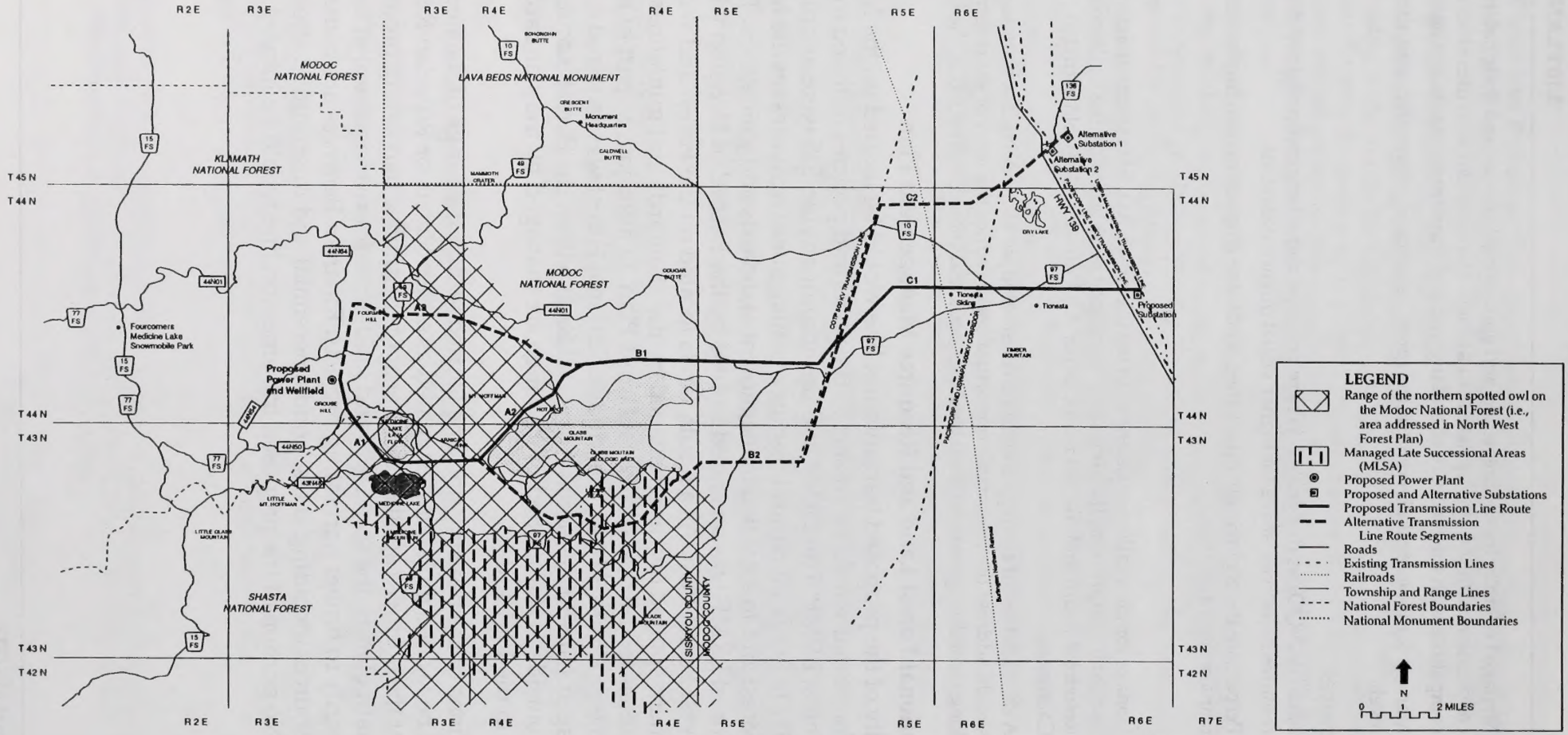
- Manage for air quality consistent with the Clean Air Act. Management activities also shall comply with the air quality standards established by the California Air Resources Board and the Siskiyou County Air Pollution Control District in California.
- A dust abatement strategy should be considered for all projects. Each strategy should address the reasonable opportunities to reduce the level of short-term and long-term dust generated from existing roads and those constructed in the future.

Modoc National Forest Land and Resource Management Plan

The majority of the proposed transmission line would be located on the Modoc National Forest and would be subject to the plans and policies outlined in the Modoc National Forest LRMP. The LRMP and the accompanying EIS were adopted by the USFS in 1991 to guide all natural resource management activities on the Modoc National Forest and to establish management standards and guidelines. The Modoc National Forest LRMP was amended in 1994 by the Record of Decision which adopted the Northwest Forest Plan. As a result, lands located on the Forest and within the range of the northern spotted owl are managed by the standards and guidelines in the 1991 LRMP, as amended by the Northwest Forest Plan. In addition, as part of the Northwest Forest Plan (see Figure 3.10-2), the Modoc National Forest was required to designate three Managed Late-Successional Areas (MLSAs) within the Forest. Lands within the Forest but outside of the spotted owl's range are managed by the standards and guidelines in the 1991 LRMP.

Those portions of the transmission line located within the range of the northern spotted owl would be located on lands designated as either Matrix or Riparian Reserves. Within the range of the northern spotted owl, most of the timber harvesting project would occur on matrix lands; the standards and guidelines for management of these lands apply primarily to timber harvesting projects. Riparian Reserves are managed to protect riparian resources including lakes, ponds, perennial and intermittent streams, and wetlands. No portion of the proposed transmission line would be located within an MLSA.

Figure 3.10-2: Northwest Forest Plan Boundary and MLSA on the Modoc National Forest



Note: Project facilities on the Klamath National Forest are located within the Goosenest Adaptive Management Area

MHA *Environmental Consulting, Inc.*

SOURCE: USFS

In addition to the management guidelines outlined in the Northwest Forest Plan, the Modoc LRMP applies various "management prescriptions" to forest lands. Each of these management areas may include additional management standards and guidelines. The proposed transmission line would pass through the following types of management prescription areas:

- Timber-Visual/Timber-Forage/Uneven-Aged Timber — Timbered areas managed for a partial retention visual quality objective.
- Even-Aged Timber/Timber-Forage/Uneven-Aged Timber — Timbered areas managed for a modification visual quality objectives.
- Rangeland —Priority is to manage rangeland vegetation to provide for healthy ecosystems and make forage available for use by livestock, wildlife, and wild horse herds.
- Range-Forage — Management priorities are the same as for rangeland, but objectives are achieved through structural and non-structural wildlife and livestock improvement projects.

Similar to the Klamath National Forest LRMP, the EIS prepared for the Modoc National Forest LRMP identifies "released roadless areas" located on the Forest. The following discussion describes policies related to released roadless areas on the Forest, as well as applicable plans and policies from the Modoc National Forest LRMP.

Released Roadless Areas: As shown in Figure 3.10-1 there are several released roadless areas on the Modoc National Forest in the general region of the proposed project. The proposed transmission line would only cross a portion of the Mount Hoffman released roadless area. The total size of this released roadless area is 11,300 acres, with 10,800 acres of that located in the Modoc National Forest.

Approximately 2 miles of transmission line segment A2 would be located within the Mount Hoffman released roadless area (see Figure 3.10-1). As discussed for the Klamath National Forest, proposed projects that would substantially alter the undeveloped character of an inventoried roadless area of 5,000 acres or more require the preparation of an EIS.

Applicable Plans and Policies: The following discussion summarizes applicable standards and guidelines from the Modoc National Forest LRMP for the proposed project.

Energy

- Provide new energy sources by allowing wind, geothermal, solar hydroelectric, and biomass development. Accommodate development of geothermal, gas, and oil resources.
- Permits, leases, and operating plans will contain provisions that prohibit unnecessary disturbance of the surface and provide for reasonable surface restoration. Special lease stipulations, permit clauses, or conditions related to operating plans will be applied as needed on a case-by-case basis. Require reclamation plans for rehabilitation of the surface and vegetation.

Minerals Management

- Locate structures, support facilities, and roads outside Riparian Reserves. Where no alternative to siting facilities in Riparian Reserves exists, locate them in a way

compatible with Aquatic Conservation Strategy objectives. Road construction will be kept to the minimum necessary for the approved mineral activity. Such roads will be constructed and maintained to meet roads management standards and to minimize damage to resources in the Riparian Reserve. When a road is no longer required for mineral or land management activities, it will be closed, obliterated, and stabilized.

Utility Corridors

- Limit allocations of single-purpose transmission and transportation corridors. Place new transportation and utility facilities within or contiguous to existing corridors. Encourage the use of private lands, where appropriate, for new corridors. Appropriateness is determined at the site-specific project level.
- Minimize proliferation of separate utility corridors by confining future needs to existing corridors, if possible. However, consider construction of new corridors outside existing utility rights-of-way if technology, safety, national and state practices, engineering, or environmental quality precludes coexisting uses.
- When establishing utility corridors, avoid the following areas:
  - Critical habitat for threatened and endangered species
  - Designated Wilderness
  - Research Natural Areas
  - Semi-primitive recreation areas
  - Special Interest Areas
  - Areas used in the practice of Native American religions

Roads

- Plan, design, and construct local roads to the lowest standard commensurate with intended use.
- New culverts, bridges, and other stream crossings shall be constructed to accommodate at least the 100-year flood, including associated bedload and debris.
- For each existing or planned road in a Riparian Reserve, meet LRMP objectives by:
  - Minimizing road and landing locations in Riparian Reserves;
  - Minimizing disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow; and
  - Avoiding wetlands entirely when constructing new roads.
- In Riparian Reserves, minimize sediment delivery to streams from roads. Outsloping of the roadway surface is preferred, except in cases where outsloping would increase sediment delivery to streams or where outsloping is unfeasible or unsafe. Route road drainage away from potentially unstable channels, fills, and hillslopes.

Hydrology

- Where potential loss or diversion of flow exists, quantify and maintain necessary in-stream flows to protect such beneficial uses as fisheries, recreation, and aesthetics.

Cultural Resources

- Follow the requirements of Section 106 of the National Historic Preservation Act (NHPA) of 1966 (as amended) Inventory to identify cultural resource properties prior to any project, activity or license which may affect significant cultural

resources consistent with the NHPA and other pertinent laws and regulations. Adjustments will be made to projects to comply with cultural resource laws.

- Protect access and use of sites and locations important to traditional Native American religious and cultural practices consistent with the American Indian Religious Freedom Act of 1978.

Biology

- On Matrix lands, coarse woody debris already on the ground should be retained and protected to the greatest extent possible from disturbance during treatment which might otherwise destroy the integrity of the substrate.
- On Matrix lands, modify site treatment practices, particularly the use of fire and pesticides, and modify harvest methods to minimize soil and litter disturbance.
- On Matrix lands, provide for retention of old-growth fragments in watersheds where little remains.

Visual Resources

- Manage visual resources to prevent unacceptable alteration of landscapes by designing and implementing management activities to meet or exceed adopted Visual Quality Objectives (VQOs).

Air Quality

- Follow dust abatement procedures prior to and during any construction activity.

BLM Alturas Resource Area Resource Management Plan

The Alturas Resource Area Resource Management Plan was developed by the BLM to provide management guidelines and objectives for lands under their jurisdiction in the Alturas Resource Area. The proposed project would be located entirely on National Forest lands. The BLM only has management authority for subsurface resources in National Forest lands. In the case of the proposed project, the BLM has authority to regulate exploration and development of the geothermal resource. The Alturas Resource Area Plan does not address the management of geothermal resources. Therefore, the plans and policies in the Alturas Resource Area Plan are not applicable to the proposed project.

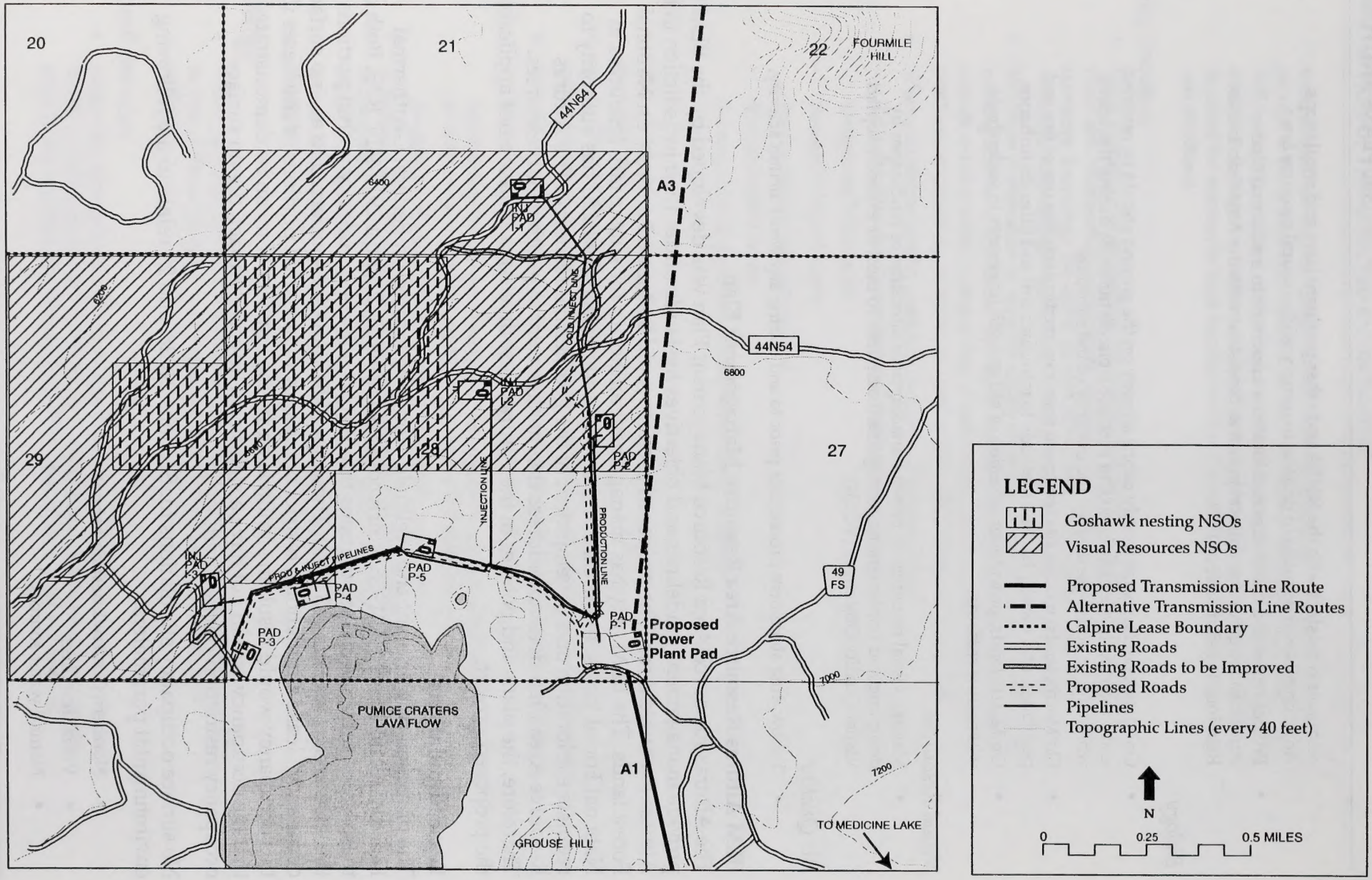
Lease Stipulations

The proposed power plant and wellfield would be located on Federal Geothermal Leases CA21924 and CA21926 which cover Sections 21, 28, and 29, T44N, R3E. Both of these leases carry special stipulations that restrict surface occupancy within portions of the lease areas (see Figure 3.10-3). These special stipulations, referred to as "no surface occupancy" lease stipulations, restrict occupancy of specified portions of the leases if this occupancy would result in significant adverse impacts. If it can be demonstrated that the occupancy would not have a significant adverse impact, the no surface occupancy restriction can be lifted.

No surface occupancy stipulations for Sections 21, 28, and 29 relate to the following environmental parameters:

- Northern Goshawk nesting habitat
- Visual resources
- Natural water sources

Figure 3.10-3: No Surface Occupancy Lease Stipulations



MHA *Environmental Consulting, Inc.*

SOURCE: Calpine

No surface occupancy areas for northern goshawk exist in Sections 28 and 29 (see Figure 3.10-3). The stipulations for these areas state that no surface-disturbing activities will be permitted in these areas from April 1 to August 30. However, if it can be demonstrated that no significant adverse impacts would occur to goshawk nesting habitat in these areas from surface-disturbing activities, these activities would be permitted between April 1 and August 30. The stipulations for northern goshawk do not restrict surface-disturbing activities at Sections 28 and 29 between August 31 and March 30. The proposed power plant and wellfield facilities would not be located within the goshawk no surface occupancy area. In addition to the no surface occupancy restrictions contained in the leases, the USFS has developed additional guidance on restricting activities in the vicinity of the no occupancy areas; see Section 3.8, Wildlife for a discussion of these limitations.

No surface occupancy areas for visual resources exist in Sections 21, 28, and 29 (see Figure 3.10-3). The stipulations for these areas state that no surface-disturbing activities will be permitted unless it can be demonstrated that impacts would not occur to areas with exceptional visual qualities within the no surface occupancy areas. Four of the proposed well pads (P-2, I-1, I-2, and I-3) would be located within the no surface occupancy areas related to visual resources in Sections 21, 28, and 29.

Calpine's Federal geothermal leases also stipulate that no surface disturbance is allowed within 700 feet of streams, lakes, ponds, springs, wet meadows, or other water sources unless specifically permitted by the Forest Supervisor. The proposed power plant and wellfield facilities would not be located within 700 feet of a water source.

Siskiyou County General Plan

The proposed plant site and the western half of the transmission line would be located on the Klamath and Modoc National Forests within Siskiyou County. The Siskiyou County General Plan does not address Federal lands located within Siskiyou County (Siskiyou County 1980). Therefore, the plans and policies included in the Siskiyou General Plan do not apply to the proposed project.

Modoc County General Plan

The eastern half of the proposed transmission line would be located on the Modoc National Forest within Modoc County. The Land Use Element of the Modoc County General Plan outlines a few plans and policies regarding Federal lands located within the County (Modoc County 1988). The only applicable policy to the proposed project is as follows:

- Provide Planning Commission review of transmission lines or other facilities which are undertaken by agencies exempt from County regulations in order to provide focus for County and public input.

ALTERNATIVES

For Alternatives 2 through 6, the plans and policies related to the proposed wellfield and power plant would be the same as described for the proposed project since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and applicable plans and policies for these portions of the transmission line are not repeated under each

alternative discussion. The description of the alternatives focuses on the segments of the alternative transmission line routes that would be different from those in the proposed action and any additional plans and policies that would be associated with these segments.

Alternative 2 (A1, A2, B1, and C2)

Under Alternative 2, transmission line segment C2 would replace segment C1. Segment C2 would pass through the southern edges of the Lavas and Dobie Flat released roadless areas (see Figure 3.10-1). The total size of the Lavas released roadless area is approximately 25,400 acres, and Dobie Flat released roadless area is approximately 12,900 acres. Approximately 1.5 miles of segment C2 would be located within the Lavas released roadless area, and approximately 1 mile within the Dobie Flat area. All of the plans and policies described under the proposed action would also apply to this alternative.

Alternative 3 (A1, B2, and C1)

Under Alternative 3, transmission line segment B2 would replace segments A2 and B1.

With Alternative 3, the transmission line would not pass through the Mount Hoffman released roadless area, and the policies related to released roadless areas would not apply to this alternative. All of the other plans and policies described for the proposed action would apply to Alternative 3.

A portion of segment B2 of the transmission line would pass through one of the MLSAs designated by the Modoc National Forest. This land is subject to the management policies for MLSAs outlined in the Modoc National Forest LRMP, as amended by the Northwest Forest Plan. Standards and guidelines for MLSAs that would apply to Alternative 3 include:

- Road construction in Managed Late-Successional Areas for silvicultural, salvage, or other activities generally is not recommended unless potential benefits exceed the costs of habitat impairment. If new roads are necessary to implement a practice that is otherwise in accordance with these guidelines, they will be kept to a minimum, be routed through non-late successional habitat where possible, and be designed to minimize adverse impacts. Alternative access methods should be considered to provide access for activities in reserves.
- The impacts of ongoing and proposed mining actions will be assessed, and mineral activity permits will include appropriate stipulations (e.g., seasonal or other restrictions) related to all phases of mineral activity. The guiding principle will be to design mitigation measures that minimize detrimental effects to late-successional habitat.
- Development of new facilities that may adversely affect Managed Late-Successional Areas should not be permitted. New development proposals that address public needs or provide significant public benefits, such as powerlines, pipelines, reservoirs, recreation sites, or other public works projects will be reviewed on a case-by-case basis and may be approved when adverse effects can be minimized and mitigated. These will be planned to have the least possible adverse impacts on late-successional areas. Developments will be located to avoid degradation of habitat and adverse effects on identified late-successional species.

Alternative 4 (A1, B2, and C2)

Under Alternative 4, transmission line segment B2 would replace segments A2 and B1, and segment C2 would replace segment C1. As described above, segment C2 would pass through the Lavas and Dobie Flat released roadless areas. All of the plans and policies described under the proposed action would also apply to this alternative; in addition, the policies for Managed Late-Successional Areas described under Alternative 3 would also apply to Alternative 4.

Alternative 5 (A3, B1, and C1)

Under Alternative 5, transmission line segment A3 would replace segments A1 and A2. With this alternative, the transmission line would not pass through the Mount Hoffman released roadless area, and the policies related to released roadless areas would not apply to this alternative. All of the other plans and policies described for the proposed action would apply to Alternative 5.

Alternative 6 (A3, B1, and C2)

Under Alternative 6, transmission line segment A3 would replace segments A1 and A2, and segment C2 would replace segment C1. Under Alternative 6, the transmission line would not pass through the Mount Hoffman released roadless area, but it would pass through the Lavas and Dobie Flat released roadless areas. All of the plans and policies described under the proposed action would also apply to this alternative.

Alternative 7 (No Action)

Under Alternative 7, the No Action alternative, no actions would occur, and the area would continue to be managed under existing plans and policies.

3.11 Land Use and Recreation

DEFINITION OF STUDY AREA

The study area for the land use and recreation analysis of the proposed action includes the area encompassing the proposed power plant site, wellfield, and the proposed and alternative transmission line routes on the Klamath and Modoc National Forests. These facilities extend from approximately Grouse Hill on the west to the Malin-Warner transmission line on the east. The Lava Beds National Monument and Primary Forest Route 97 serve as the northern and southern boundaries of the study area, respectively (see Figure 2.2-2).

METHODOLOGY

In order to conduct the analysis of land use and recreation uses for the proposed action and alternatives, the Klamath National Forest LRMP (USFS 1994a) and Modoc National Forest LRMP (USFS 1991a) were reviewed for existing land use and recreation activities. In addition, USFS and Lava Beds National Monument personnel were consulted regarding general recreational uses, and California Department of Parks and Recreation personnel were consulted for information on snowmobiling. Site visits were conducted during July through October 1996 to further document land use and recreation, and recreational users were randomly interviewed to obtain information on current recreational uses and patterns.

REGIONAL OVERVIEW

Land Use

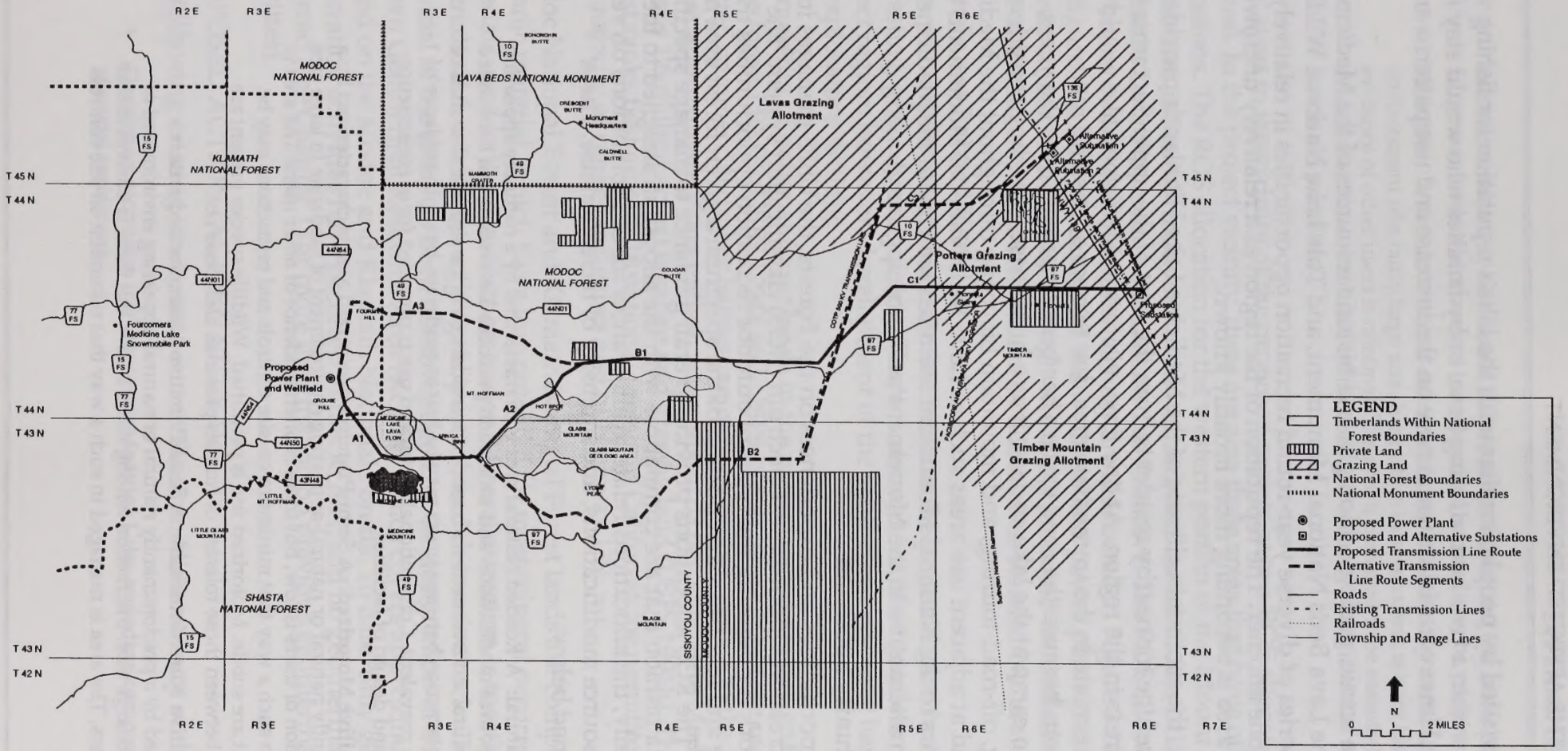
Lands in the vicinity of the proposed action are generally undeveloped areas consisting of forested lands in the Medicine Lake Highlands and scrub vegetation to the north in Lava Beds National Monument and to the east in the Tionesta area. The majority of land in the project region is public land within the Klamath National Forest and the Modoc National Forest. However, private land in-holdings occur in the vicinity of the proposed transmission line route and route alternatives, including areas on the south shore of Medicine Lake, the Tionesta community, the Dry Lake area, and several other private in-holdings located between Lava Beds National Monument on the north and the Medicine Lake Highlands on the south.

The project region has relatively sparse human habitation, and there has been relatively little development in the region. Small communities, towns, and homesteads are scattered throughout the region. Land uses in the region consist mainly of a variety of recreational and other forest-related uses, such as selective timber harvesting, grazing, and mining. Figure 3.11-1 identifies the general locations of these land uses.

Recreational Uses

From a regional perspective, the role of the Medicine Lake Highlands as a recreation destination point is changing. Historically, in terms of driving time, the presence of Mount Shasta has served as somewhat of a physical barrier to the use of the Medicine Lake Highlands as a weekend recreation destination by the burgeoning urban populations of central and southern California. The Medicine Lake Highlands have

Figure 3.11-1: Land Uses in the Project Vicinity



MHA *Environmental Consulting, Inc.*

SOURCE: USFS

traditionally been visited by people familiar with the lake's reputation for fishing who would come from within a two-hour driving time, or by families who would stay for an extended vacation. However, visitor use is now on the increase and use patterns are changing.

Taken together, the scenic, geologic, biologic, and historic resources of the Medicine Lake Highlands, the Lava Beds National Monument, and Tule Lake National Wildlife Refuge provide a series of diverse year-round recreation opportunities in relatively close proximity to one another. The reputation of the region as a relatively uncrowded tourist destination area is becoming more broadly known.

In the summertime, the mountain climate of the Medicine Lake Highlands provides a readily-accessible refuge for nearby residents from the heat of the upper Sacramento Valley and lower areas in the region. At one time, visitors to Medicine Lake would typically stay and recreate in the immediate area due to poor access and road conditions. However, because the road system has been improved over the years, visitors now tend to camp at the lake and use it as a home base, spending considerable time scenic driving, off-road touring, and mountain bicycling throughout the Medicine Lake Highlands and at adjacent use areas such as Lava Beds National Monument. Additionally, visitors to the National Monument are often referred to the Medicine Lake campgrounds as an alternative to the Monument's own campground.

Recreation Opportunity Spectrum

For recreational opportunities and experiences on the Forests, the USFS manages its lands using the Recreation Opportunity Spectrum (ROS) classification system. The ROS provides a framework for defining the types of outdoor recreation opportunities the public might desire and identifies that portion of the spectrum a given forest area might be able to provide. The ROS allocations provide overall guidance to manage specific projects or areas in a fashion that are compatible with the allocation assigned to the overall area. Typically, the allocations relate to allowances for or prohibitions on vehicle travel, degree of resource modifications, and intensity of recreation use. These allocations are defined below.

- **Roaded Natural:** A Roaded Natural area is characterized by a naturally appearing setting. Resource modification and utilization practices are evident, but harmonize with the natural environment with moderate evidences of the sights and sounds of humans. Interaction between users may be low to moderate, but with evidence of other users prevalent. Conventional motorized use is provided for in construction standards and design of facilities.
- **Semi-Primitive Motorized:** A Semi-Primitive Motorized area is characterized by a predominantly natural or natural-appearing environment of moderate to large size. Concentration of users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls and restrictions may be present, but are subtle. Motorized use is permitted. Wildlife species present are mid-range between those tolerant of human presence and those not.
- **Semi-Primitive Non-Motorized:** A Semi-Primitive Nonmotorized area is characterized by a predominantly natural or natural-appearing environment of moderate to large size. Interaction among users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls

and restrictions may be present, but are subtle. Motorized use is not permitted. Large mammals which are not too tolerant of humans may be present.

- **Primitive:** A Primitive area is characterized by an essentially unmodified natural environment of a fairly large size. Interaction between users is very low and evidence of other users is minimal. The area is managed to be essentially free from evidence of human-induced restrictions and controls. Motorized use within the area is not permitted.

Most areas in the vicinity of the proposed project have a ROS allocation of Roaded Natural. In the project vicinity, there are also three areas that have other ROS allocations. The ROS allocation for the western portion of the Mount Hoffman roadless release area is Semi-Primitive Non-Motorized, and the Medicine Lake and Glass Mountain Lava Flows are both allocated as Primitive. The ROS allocation for portions of the Forests in the Medicine Lake vicinity are illustrated in Figure 3.11-2. As shown in this figure, the ROS allocation for the wellfield and power plant area is Roaded Natural. The remainder of the Forest through which the proposed transmission line route and route alternatives pass is also primarily allocated as Roaded Natural.

Other Forest-Related Uses

Other primary forest-related uses that occur in the project region include timber harvesting, grazing, and mining. There is also an identified geothermal potential in the project region; however, development of the geothermal resource has been limited to the exploratory drilling.

The majority of national forest lands in the project region are designated as timber lands in the forest LRMPs(USFS 1994a and USFS 1991a). The Forests are managed to allow for selected commercial timber harvesting of these timber lands. On the Modoc National Forest, approximately one million acres (about 63 percent of the Modoc National Forest's 1.6 million acres) is range and grazing land (USFS 1991b). The Modoc National Forest ranks first among 18 national forests in California for permitted livestock forage. The majority of range land exists east of Highway 139.

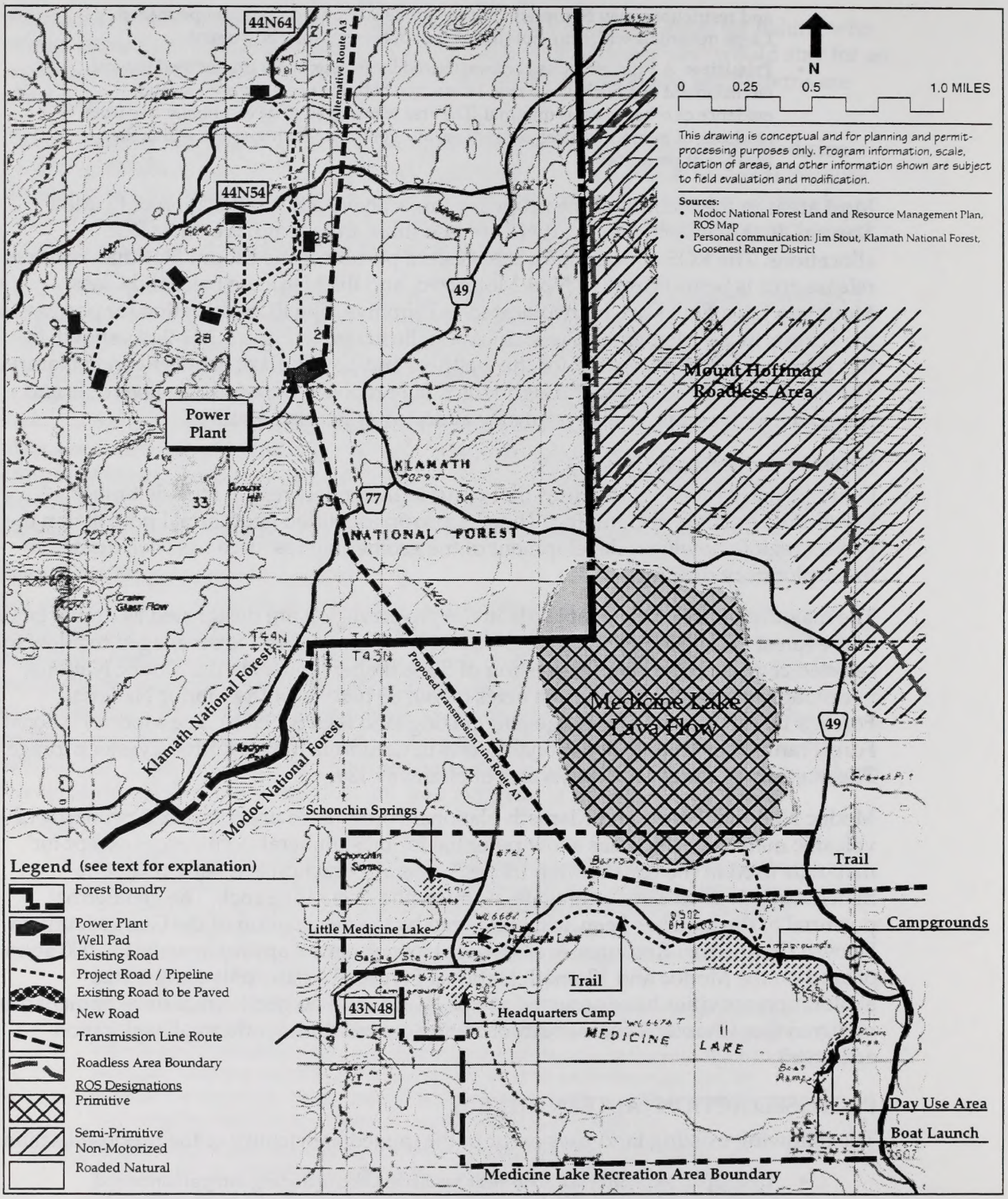
Modoc National Forest and Klamath National Forest lands are composed primarily of volcanic material, which has a low potential for most mineral occurrences except for materials used in the construction trades. Mineral extraction is mostly related to materials such as cinders, aggregate, pumice, and decorative rock. The geothermal potential of the area has been acknowledged by the designation of the Glass Mountain Known Geothermal Resource Area (KGRA), which covers approximately 161,000 acres of land on the Modoc and Klamath National Forests. To date, only geothermal exploration activities have occurred at this KGRA, and no geothermal development has occurred (see Chapter 1 for more information on previous geothermal exploration activities).

PROPOSED ACTION (ALTERNATIVE 1)

The following existing land uses occur in the immediate vicinity of the proposed action:

- Developed recreation use areas near Medicine Lake, including campgrounds and seasonal residences

Figure 3.11-2: Recreation Features in the Medicine Lake Area



- Dispersed recreation activities such as hunting, and snowmobiling, primarily in the Medicine Lake Highlands area
- Recreation uses at Lava Beds National Monument
- The year-round residential community in Tionesta
- Potential commercial timber harvesting in timberlands, located primarily west of Tionesta Siding
- Grazing on rangelands east and north of Tionesta Siding
- Mining extraction and geothermal exploration activities
- Mushroom harvesting

There are no prime agricultural lands in the vicinity of the proposed action. The following discussion describes each of the land uses that occur in the project vicinity.

Developed Recreation Areas and Facilities

Developed recreation areas and facilities in the vicinity of the proposed action include the Medicine Lake recreation area, and the Little Mount Hoffman Lookout.

Medicine Lake: The boundaries of the developed recreation area at Medicine Lake, which is generally centered on Medicine Lake, are shown in Figure 3.11-2. This area includes concentrated public use for more traditional recreation uses (such as campgrounds, picnic areas, and swimming areas). No hunting is permitted and other management controls are applied, such as limitations on dispersed camping. Additionally, in the lands surrounding Medicine Lake, motorized vehicle travel is prohibited off of existing roads and trails, but permitted on existing roads and trails except those designated as closed. The Medicine Lake Lava Flow and Glass Mountain Lava Flow are closed to motor vehicle travel.

Most of the developed recreation uses within the Medicine Lake recreation area are located on the shores of Medicine Lake. As shown in Figure 3.11-2, a variety of facilities have been developed within the area, including:

- Four campgrounds along the lake's northern and northwest shoreline
- A day use area consisting of a boat launch, picnic facilities, and a swimming beach located along the lake's eastern shoreline
- Picnic facilities and trail staging at Little Medicine Lake
- Trails connecting the day use areas, campgrounds, Little Medicine Lake and the Medicine Lake Lava Flow
- An undeveloped, designated overflow camping area located at Schonchin Springs, just northwest of Medicine Lake

Table 3.11-1 lists developed public recreation facilities in the Medicine Lake area. Typical developed recreational activities in this area during the summer months include camping, fishing, picnicking, boating, swimming, and hiking. The campgrounds and day use facilities at Medicine Lake are generally open from late May or June to mid-October of each year, depending on snow conditions, and are closed for the remainder of the year.

Table 3.11-1: Public Recreation Facilities In Study Area

Area		Size	Use notes
Medicine Lake	Headquarters Campground	10 Units	Camping
	Medicine Lake Campground	22 Units	Camping
	A.H. Hogue Campground	24 Units	Camping
	Hemlock Campground	19 Units	Camping
	Day Use Area and Boat Ramp		Fishing, swimming, boating, picnicking, and water-skiing
	Little Medicine Lake Picnic Area		Picnicking and passive activities
	Medicine Lake Trail		Connects campgrounds; moderate hiking and bicycle use
	Little Medicine Lake Loop Trail		Loop trail circles Little Medicine Lake / moderate to heavy use
	Medicine Lake Lava Flow Trail		Connects campgrounds with Lava Flow; moderate to heavy use
Shasta-Trinity National Forest	Little Mount Hoffman Lookout	1 Unit	Reservation only accommodation
Lava Beds National Monument	Campground	40 Units	Camping
	Visitor Center / Picnic Area		Visitor Information and picnicking
	Captain Jack's Stronghold		Picnicking
	Fleener Chimneys		Picnicking

SOURCE: 2M ASSOCIATES 1996

Peak use at the Medicine Lake recreation area usually occurs during holiday periods such as Memorial Day, Fourth of July, and Labor Day weekends. The USFS does not plow roads to Medicine Lake during the winter season, which hinders winter access to the lake. However, snowmobiling and cross-country skiing occur around in the vicinity during the winter season (see the discussion of dispersed recreation areas later in this section).

An estimated 40,000 recreationalists visit the Medicine Lake recreation area each year, and the use of this area has increased by 8% to 10% per year over the past three years. Although weather conditions may permit a longer operating season, the majority of users visit the recreation area between Memorial Day (in late May) and Labor Day (in early September). During the months of July and August 1996, the campgrounds were observed to operate at an average 65% occupancy rate during the week (Monday through Thursday). On weekends and during summer holiday periods, the campgrounds generally operated at capacity. During September, campground use

generally dropped by one-third. During the Fourth of July holiday weekend in 1996, tent camping accounted for approximately 60% of camping use in the recreation area, with the remainder using recreational vehicles. Approximately 35% of all the campers had boats used on the lake, and about 15% of the campers brought along bicycles (2M Associates 1996).

Approximately one third of the campground users at Medicine Lake (as indicated by zip-code information provided on fee-envelopes) are from the Redding area. A substantial number of visitors come from central and southern California, compared to visitors originating in the Klamath Falls/Medford areas of Oregon (Parker 1978). During the Fourth of July holiday weekend in 1996, approximately 90% of the campers were from California, with the remaining 10% primarily from Oregon and Nevada (2M Associates 1996).

The Medicine Lake recreation area also includes three recreation residences (under special use permit from the USFS) and about 35 recreation residences located on private lands adjacent to the lake (see Figure 3.11-2). The private residences are clustered near the southern and southeastern edge of Medicine Lake. These residences are generally accessible only during the summer months since the USFS does not plow roads to Medicine Lake in the winter and winter access is difficult due to snow conditions. However, some owners of these residences occasionally use their residences in the winter when weather conditions allow, while others occasionally access their residences with snowmobiles even during extreme snow conditions.

Little Mount Hoffman Lookout: Little Mount Hoffman is located on the Shasta-Trinity National Forest, about two miles west of Medicine Lake (see Figure 3.11-2). As identified in Table 3.11-1, at the top of Little Mount Hoffman is a former fire observation cabin (referred to as the "Little Mount Hoffman Lookout") that has been converted into an overnight rental unit for the public. The Lookout is available for rent throughout the year on a permit basis that involves a daily rental fee. Since it opened to the public three years ago, use has grown steadily to the point that it is now fully booked well in advance for the Thursday through Sunday (i.e., weekend) period during the summer months. Weekday reservations are now also becoming limited.

Dispersed Recreation Areas

Approximately 80% of the recreation activities available in the Klamath and Modoc National Forests relate to dispersed recreation uses and activities. Use levels on the Doublehead Ranger District of the Modoc National Forest are currently at just over 200,000 visits per year. Annual use of the Medicine Lake Highlands area for dispersed recreation uses has increased by 8% to 10% per year over the past three years. As described below, dispersed recreation uses in the project vicinity vary between the summer months and the winter months.

Summer Dispersed Recreation Uses: Similar to developed recreational uses, most dispersed recreational use in the Medicine Lake Highlands occurs between June and October. This is due primarily to the availability of campsites at campgrounds near Medicine Lake during this period, and the cold weather and snow during other times of the year.

Hunting and recreational driving for the purposes of sightseeing on the many primitive roads in the Modoc and Klamath National Forests are the primary recreational activities that occur in dispersed recreation areas in the summer. Camping, nature study, hiking, bicycling, and off-road vehicle use are other typical dispersed recreational activities that occur in these areas during summer months. Although all forest roads are used in the area for dispersed recreation, popular routes of travel for sightseeing and accessing dispersed recreation uses include:

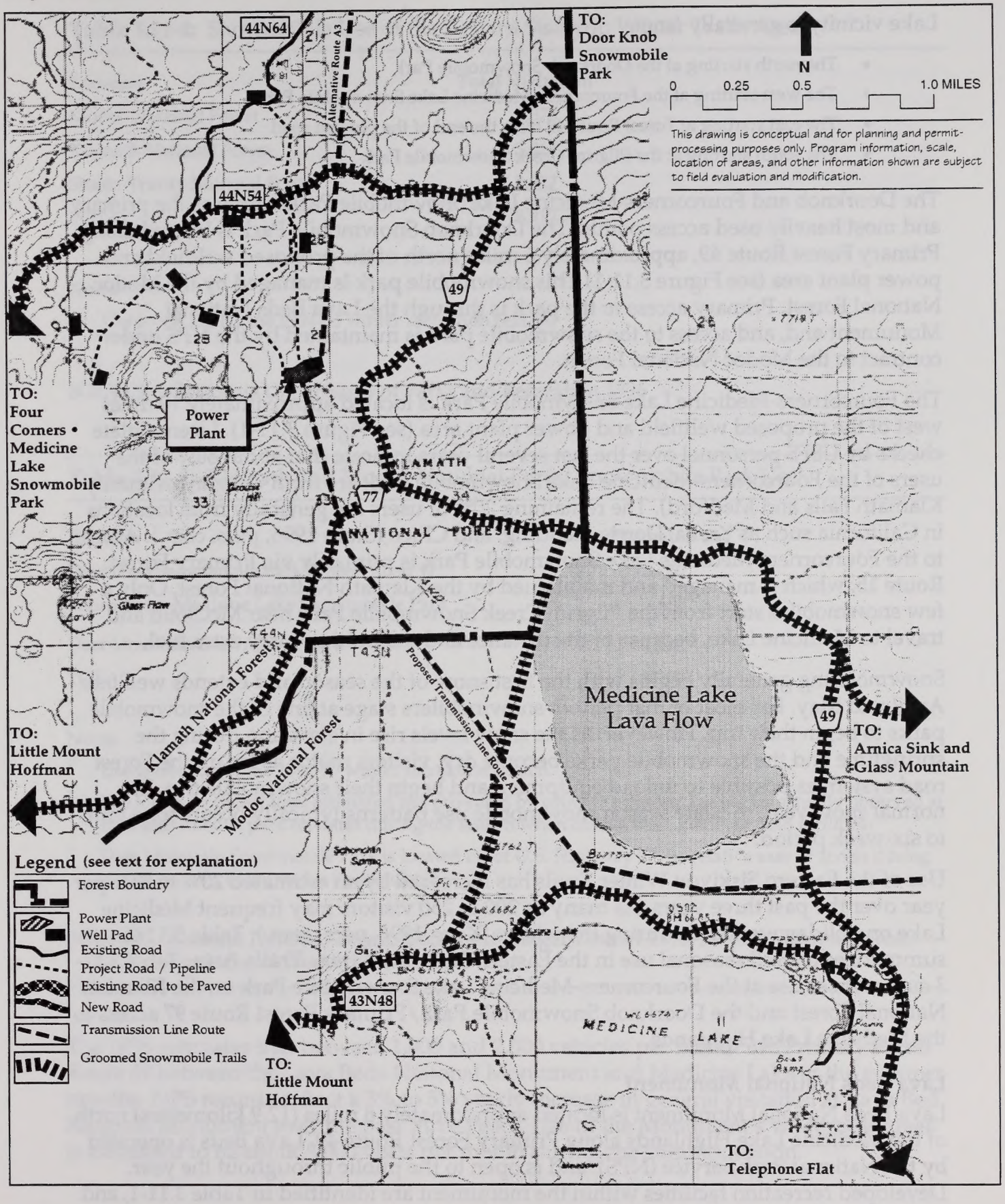
- Primary Forest Route 49 between Medicine Lake and Lava Beds National Monument
- Primary Forest Route 97
- Forest Roads 43N53 and 43N99 (Lyons Peak Loop Road) to access the Glass Mountain Lava Flow
- Forest Road 43N48 between Medicine Lake and Little Mount Hoffman Lookout

Roadless release areas in the project vicinity are also used for dispersed recreation. These areas have been "released" from consideration to be designated as Wilderness, but are often generally managed by the USFS to meet some of the same objectives as wilderness (see Section 3.10, Plans and Policies for a more detailed description of roadless release areas in the project vicinity). Most roadless release areas in the project vicinity either have existing roads or have been partially subject to human disturbance in the past from activities such as timber harvests (which is one of the reasons that these areas have not been designated as wilderness). New roads and motorized travel are generally not permitted by the USFS within roadless release areas on the Modoc National Forest except to meet management needs or when specifically allowed by the USFS. Roadless release areas in the immediate project vicinity include the Mount Hoffman, Lavas, and Dobie Flat roadless release areas (see Section 3.10, Plans and Policies).

Winter Dispersed Recreation Uses: Although the majority of dispersed recreation use occurs during the summer, these uses also occur during the winter on a more limited basis. Snowmobiling and cross-country skiing are the primary dispersed recreation uses that occur in the project vicinity during the late fall, winter, and spring months when snow is on the ground. Snowmobiling and cross-country skiing occur in the Medicine Lake Highlands area primarily in the designated Eastern Siskiyou Winter Trails Area on the Klamath, Modoc, and Shasta-Trinity National Forests. This area includes a network of approximately 225 miles (362 kilometers) of signed, groomed snowmobile trails linking four snowmobile parks. Snowmobile trails are prioritized for grooming, and trails leading directly from the snowmobile parks to Medicine Lake are among the first to be groomed. Figure 3.11-3 illustrates the groomed snowmobile trails in and near the project area.

Medicine Lake is a major destination point in the Eastern Siskiyou Winter Trails Area for many snowmobilers, and there are several snowmobile parks and staging areas in the project vicinity. Other popular destination areas for snowmobilers near the project area are the open areas around Primary Forest Route 49 north of the Medicine Lake Lava Flow, Arnica Sink, and the Glass Mountain Lava Flow. Access to the Medicine

Figure 3.11-3: Groomed Snowmobile Trails



Lake vicinity is generally from:

- The north starting at the Doorknob Snowmobile Park
- The west starting at the Fourcorners-Medicine Lake Snowmobile Park
- The east starting at Forest Route 49 from the end of the plowed road
- The south starting at the Pilgrim Creek Snowmobile Park

The Doorknob and Fourcorners-Medicine Lake Snowmobile Parks serve as the primary and most heavily used access points. The Doorknob Snowmobile Park is located along Primary Forest Route 49, approximately 6 miles north of the proposed wellfield and power plant area (see Figure 3.11-1) This snowmobile park is managed by the Modoc National Forest. Primary access to the park is through the Lava Beds National Monument and, and access to the snowmobile park is maintained by the NPS under contract to the Modoc National Forest.

The Fourcorners-Medicine Lake Snowmobile Park is located approximately 10 miles west of the proposed wellfield and power plant area (see Figure 3.11-1). License plate checks by USFS personnel over the last several years indicate that about 80% of the users of the Fourcorners-Medicine Lake Snowmobile Park are from Oregon (primarily Klamath Falls and Medford). The remaining 20% of users are generally from locations in California such as Yreka, Dorris, Redding, and Chico (Stout 1996, pers. com.). Access to the Fourcorners-Medicine Lake Snowmobile Park is primarily via Primary Forest Route 15, which is managed and maintained by the Klamath National Forest. Only a few snowmobiles start from the Pilgrim Creek Snowmobile Park near McCloud and travel to Medicine Lake, because of the distance and the need to carry extra fuel.

Snowmobiling generally begins with the first snow of the season and extends well into April and May. For most of that period, snowmobilers stage at one of the snowmobile parks to begin their trip. However, as the snow levels rise in elevation during the springtime and the snowmobile parks become dry, visitors motor as far up the Forest road system as possible to unload equipment and begin their snowmobile trip. In a normal snow year, this late season snowmobile use patterns typically occurs for a four- to six-week period.

Use of the Eastern Siskiyou Winter Trails has increased by an estimated 20% to 25% per year over the past three years. As many as 200 to 250 visitors may frequent Medicine Lake on holiday weekends during the winter (Kegg 1996, pers. com.). Table 3.11-2 summarizes overall seasonal use in the Eastern Siskiyou Winter Trails Area. Table 3.11-3 summarizes use at the Fourcorners-Medicine Lake Snowmobile Park on the Klamath National Forest and the Doorknob Snowmobile Park/Primary Forest Route 97 access to the Medicine Lake Highlands.

Lava Beds National Monument

Lava Beds National Monument is located approximately 8 miles (12.9 kilometers) north of the Medicine Lake Highlands along Primary Forest Route 49. Lava Beds is operated by the National Park Service (NPS), and is open to the public throughout the year. Developed recreation facilities within the monument are identified in Table 3.11-1, and generally include a campground, several picnic areas, and a visitor's center.

Table 3.11-2: Snowmobile Use of the Eastern Siskiyou Winter Trails Area[1]

Location	Total Visitation
Modoc National Forest	2,978
Klamath National Forest	3,012
Shasta-Trinity National Forest	2,927
TOTAL	8,917

Notes:

[1] Use levels are for the 1994-95 winter recreation season.

SOURCE: California Department of Parks and Recreation 1996

Table 3.11-3: Klamath and Modoc National Forest Snowmobile Park Use[1]

Location	Estimated Use[2]
Doorknob Snowmobile Park/Forest Road 97	3,760
Fourcorners-Medicine Lake Snowmobile Park	698
Deer Mountain Snowmobile Park[3]	2,314
TOTAL	6,772

Notes:

[1] Use levels are for the 1994-95 winter recreation season.

[2] Use levels represent total estimated use pro-rated by using the percentage of cars actually observed at each snowmobile park on dates during the season when counts were made for both facilities.

[3] Deer Mountain Snowmobile Park is located off of U.S. Highway 97. Its relative ease of access during winter months accounts for its popularity.

SOURCE: Klamath National Forest, Goosenest Ranger District 1996; Modoc National Forest, Doublehead Ranger District 1996

The NPS estimates that between 1,000 and 2,000 vehicles per month use Primary Forest Route 49 between the Lava Beds National Monument and Medicine Lake in the summer months. NPS records reflect a 3% to 5% yearly increase in general visitation at Lava Bed National Monument over the past three years. Use of the Monument's wilderness areas is estimated to be about 8,000 visits per month during the summer season.

Residential Uses

A residential community composed of approximately 12 to 15 homes is located in the Tionesta area (see Figure 3.11-1). This community is located on private land within the Modoc National Forest just north of Timber Mountain and east of State Highway 139, near its junction with Primary Forest Route 97. The occupancy of these units is generally year round as it is at a lower elevation than Medicine Lake and remains accessible by automobile all year.

Timber Harvesting

Although the Klamath and Modoc National Forests are managed to allow for selected commercial timber harvesting of timber lands, the majority of timber lands in the vicinity of the proposed action are being managed to allow for late successional growth (Reed and Stout 1996, pers. com.). This type of management is being conducted as specified in the Northwest Forest Plan (see Section 3.10, Plans and Policies for a more detailed discussion of the Northwest Forest Plan). To provide for this management objective, only limited commercial timber harvesting activities are currently occurring in the vicinity of the proposed action. Timber harvests are also limited in the project vicinity by the existence of the developed recreational area at Medicine Lake. Typically, only salvage harvesting of dead and downed trees and thinning to encourage late successional growth are being conducted in the project vicinity (Reed and Stout 1996, pers. com.).

There are various private in-holdings in the Medicine Lake Highlands, primarily north of Glass Mountain, that are managed for timber projection, as shown in Figure 3.11-1. These in-holdings are relatively small and isolated lands located in the greater Modoc National Forest.

Grazing Uses

In the immediate project vicinity, designated range lands cover the majority of lands between the community of Tionesta and the Dry Lake area (see Figure 3.11-1). The area north of Tionesta is known as Potters Allotment, which is leased for cattle grazing. Approximately 500 cattle are grazed on Potters Allotment between May and September every year (Reed 1996, pers. com.). A portion of this area, located on lands on and adjacent to Dry Lake, is under private ownership, as shown on Figure 3.11-1.

North and west of Tionesta is an area known as Lavas Allotment, which is leased for sheep grazing during the winter. Approximately 2,000 sheep are grazed in this area between December and April (Reed 1996, pers. com.). There are no other range lands or grazing activities located on or in the immediate vicinity of the proposed action.

Mining and Geothermal Exploration

In the immediate project vicinity, mining activities generally involve mineral extraction of materials such as cinders, aggregate, and decorative rock. Pumice and block pumice are also currently being mined on the northern flanks of the Medicine Lake Highlands. There are several private in-holdings in the Highlands, either adjacent to or near the Glass Mountain Lava Flow, that are managed for pumice mining or have been previously mined, as shown in Figure 3.11-1.

Geothermal exploration activities have occurred throughout the Medicine Lake Highlands at the Glass Mountain KGRA. Extensive investigations and geophysical surveys of the geothermal resource have been conducted. A total of 24 temperature core hole wells were drilled between 1981 and 1984 to measure the temperature gradient at the KGRA. Based on the results of this drilling, four deep exploration test wells were drilled between 1984 and 1989. In the last couple of years, two exploratory geothermal drilling projects (one by Calpine, and one by California Energy General Corporation) have been proposed in the project vicinity. However with the exception of a temperature gradient hole drilled by Calpine in 1994, neither of the deep test well drilling projects has been implemented to date (see Chapter 1 for more information on geothermal exploration activities in the project vicinity).

Mushroom Harvesting

The commercial harvesting of the Matsutake pine mushroom, *Tricholoma magnivelane*, occurs throughout the area of the proposed action. The activity occurs primarily in the Lodgepole Pine, Red Fir, and Pine/White Fir vegetative communities. Harvesting of the Matsutake mushroom is a seasonal activity occurring from September through December peaking for a three week period depending on weather conditions. The harvesting of mushrooms has increased dramatically from 1994 when no permits were issued by the Goosenest Ranger District to 1996 when 865 permits were issued. The annual harvest of mushrooms from the Goosenest Ranger District is estimated to be 50,000 pounds (USFS 1997).

The power plant and wellfield and transmission line segments A1, A2, and B1 contain suitable habitat and sources of the Matsutake mushroom. In general, harvest methods consist of individual or groups of pickers (3 to 10) being dropped off on main access routes and spreading out in search of mushrooms. Pickers are picked up along main access roads in the evening.

Land Use and Recreation Within the Proposed Project Area

Wellfield and Power Plant Area: The proposed wellfield and power plant area would be located on a site approximately 850 feet west of Primary Forest Route 49 in the Medicine Lake Highlands. Many visitors enter the area from the north or south along Route 49. The wellfield and power plant site is approximately 3.5 miles north west of the Medicine Lake recreation area and associated campgrounds and residential uses.

The wellfield and power plant site is designated as timber land (USFS 1991a and 1994a). However, there are no existing commercial timber harvesting activities or pending timber sales in the vicinity of this site. During the mushroom harvesting season, hundreds of mushroom pickers converge on the project area, and 5 to 25 pickers may be in the wellfield and power plant area at one time throughout the season (USFS 1997). Dispersed recreation activities on and in the immediate vicinity of the wellfield and power plant site include hunting, snowmobiling, and possibly cross-country skiing. Forest Road 44N54 (see Figure 3.11-2), which runs through the northeastern edge of the wellfield, is a winter trail that is frequently used by snowmobiles.

Transmission Line Route: The land use and recreation uses and characteristics along the proposed transmission line route, utilizing segments A1, A2, B1, and C1, vary widely as the route alignment crosses a range of landscapes from the Medicine Lake

Highlands in the west, to the Modoc Plateau in the east. The majority of lands along segments A1, A2, and B1 are designated timber lands (USFS 1991a). However, there are no existing commercial timber harvesting activities or pending timber sales in the vicinity of the proposed transmission line alignment, and the proposed alignment does not cross any private land within the forests. Mushroom harvesting could occur along segments A1, A2, and B1.

Segment A1 crosses through the Medicine Lake recreation area and is in relatively close proximity to the campgrounds and residential uses that occur in this area. This segment alignment crosses the Medicine Lake Lava Flow Trail, and Primary Forest Routes 77 and 49, but does not cross through any other designated trails, campgrounds, residential areas, or other use areas in the Medicine Lake Recreation Management Area. Dispersed recreation activities on and in the immediate vicinity of the segment A1 alignment include hiking, mountain biking, snowmobiling, and possibly cross-country skiing.

Segment A2 heads northeast from Arnica Sink up and over the Medicine Lake Highlands, passing through the Mount Hoffman roadless released area. Dispersed recreation in the vicinity of this segment relates primarily to hiking, hunting, and some snowmobiling. There are no developed recreation areas on or in the immediate vicinity of the segment A2 alignment.

Segment B1 heads east, out of the Medicine Lake Highlands onto the Modoc Plateau. Dispersed recreation along this alignment relates primarily to hiking, hunting, and four-wheel drive vehicle use. There are no developed recreation areas on or in the immediate vicinity of the segment B1 alignment.

Segment C1 heads northeast and then east towards State Highway 139, passing just north of the community of Tionesta and Timber Mountain. The residential community of Tionesta occurs on private land, approximately 1,500 feet to the south of this proposed segment alignment. Dispersed recreation along this alignment relates primarily to hiking, hunting, and four-wheel drive vehicle use. There are no developed recreation areas on or in the immediate vicinity of the segment C1 alignment. The majority of lands along this alignment are designated grazing land under the Modoc National Forest Management Plan (USFS 1991a). Grazing of cattle does occur along this segment alignment within the Potter's Allotment.

ALTERNATIVES

As discussed at the beginning of this chapter, the following describes the affected environment for each alternative to the proposed action. Alternatives to the proposed action include various alternate transmission line routes (Alternatives 2 through 6) and the No Action alternative (Alternative 7). Figures 3.11-1 and 3.11-2 identify the general locations of land uses.

For Alternatives 2 through 6, the affected environment for the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of the existing environment along these portions of the transmission line are not repeated

under each alternative discussion. The description of the affected environment for these alternatives focuses on those segments of the transmission line that would be different from those in the proposed action, and provides references for those segments that have been previously discussed under the proposed action or a preceding alternative discussion. For Alternative 7, no discussion is provided in this Chapter since there would be no affect to the environment under this alternative.

Alternative 2 (Segments A1, A2, B1, and C2)

The existing land uses and characteristics at the proposed wellfield and power plant area are the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area, under this alternative, would occur on the same site as identified for the proposed action. The transmission line route under Alternative 2 would utilize segments A1, A2, B1, and C2. Land uses and characteristics along transmission line segments A1, A2, and B1 are the same under Alternative 2 as described above for the proposed action (Alternative 1). Existing land uses and characteristics along the segment C2 alignment are described below.

Segment C2: Similar to segment C1, the segment C2 alignment would head northeast towards State Highway 139, but it would pass further to the north through the Dry Lake area. The residential community of Tionesta occurs approximately 2.8 miles (15,000 feet) to the south of this proposed segment alignment. As for segment C1, dispersed recreation along the segment C2 alignment relates primarily to hiking, hunting, and limited four-wheel drive vehicle use. There are no developed recreation areas on or in the immediate vicinity of the segment C2 alignment. Approximately 1.5 miles of segment C2 would be located within the Lavas roadless release area, and approximately 1 mile within the Dobie Flat roadless release area.

The majority of lands along this alignment are designated grazing land under the Modoc National Forest Management Plan (USFS 1991a). Grazing of cattle and sheep does occur along this segment alignment within both the Lava's and Potter's Allotment.

Alternative 3 (Segments A1, B2, and C1)

Existing land uses and associated characteristics at the proposed wellfield and power plant area are the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area, under this alternative, would occur on the same site as identified for the proposed action. The transmission line route under Alternative 3 would utilize segments A1, B2, and C1. Land uses and characteristics along transmission line segments A1 and C1 are the same under Alternative 3 as described above for the proposed action (Alternative 1). Existing land use characteristics along the segment B2 alignment are described below.

Segment B2: The segment B2 alignment would head southeast, out of Arnica Sink area and then east along the southern side of the Medicine Lake Highlands and then down onto the Modoc Plateau. Dispersed recreation along this alignment relates primarily to hiking, hunting, and four-wheel drive vehicle use. There are no developed recreation areas on or in the immediate vicinity of the segment B2 alignment.

The majority of lands along this alignment are designated timber lands under the Modoc National Forest Management Plan (USFS 1991a). There are no existing

commercial timber harvesting activities or pending timber sales, on or in the immediate vicinity of this segment alignment. Segment B2 supports suitable habitat for the Matsutake mushroom and mushroom harvesting could occur along this segment.

Alternative 4 (Segments A1, B2, and C2)

Existing land use characteristics at the proposed wellfield and power plant area are the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area, under this alternative, would occur on the same site as identified for the proposed action. The transmission line route under Alternative 4 would utilize segments A1, B2, and C2. Land uses and characteristics along transmission line segment A1 are the same under Alternative 4 as described above for the proposed action (Alternative 1). Existing land use characteristics along the segment B2 alignment are the same as described above for Alternative 3. Existing land use characteristics along the segment C2 alignment are the same as described above for Alternative 2.

Alternative 5 (Segments A3, B1, and C1)

Existing land use characteristics at the proposed wellfield and power plant area are the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area, under this alternative, would occur on the same site as identified for the proposed action. The transmission line route under Alternative 5 would utilize segments A3, B1, and C1. Land uses and characteristics along transmission line segments B1 and C1 are the same under Alternative 5 as described above for the proposed action (Alternative 1). Existing land use characteristics along the segment A3 alignment are described below.

Segment A3: The segment A3 alignment would head northeast from the power plant, and down the northern flank of the Medicine Lake Caldera, west of Fourmile Hill. The route then turns southeast and passes between Fourmile Hill on the south and Lookout Butte on the north. The segment would then head east and southeast to a point just south of Indian Butte, cutting across the northern side of the Medicine Lake Highlands, and passing along the north side of Mt. Hoffman.

Dispersed recreation in the vicinity of this segment relates primarily to hiking, hunting, and some snowmobiling. There are no developed recreation areas on or in the immediate vicinity of the segment A3 alignment. The majority of lands along this alignment are designated timber land under the Klamath and Modoc National Forest Management Plans (USFS 1994a). There are no existing commercial timber harvesting activities or pending timber sales, on or in the immediate vicinity of this segment alignment. Segment A3 supports suitable habitat for the Matsutake mushroom and mushroom harvesting could occur along this segment.

Alternative 6 (Segments A3, B1, and C2)

Existing land use characteristics at the proposed wellfield and power plant area are the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area, under this alternative, would occur on the same site as identified for the proposed action. The transmission line route under Alternative 6 would utilize segments A3, B1, and C2. Land uses and characteristics along transmission line segment B1 are the same under Alternative 6 as described above for the proposed action

(Alternative 1). Existing land use characteristics along segment A3 are the same as described above for Alternative 5. Existing land use characteristics along segment C2 are the same as described above for Alternative 2.

Alternative 7 (No Action)

The setting for Alternative 7, the No Action alternative, would be the same as for Alternatives 1 through 6.

3.12 Transportation

DEFINITION OF STUDY AREA

The study area for the transportation analysis of the proposed project includes the road system servicing the project area within approximately ten miles of project facilities. The analysis focuses on roads that would be used by project personnel during the life of the project, including roads in the general vicinity of the proposed wellfield and power plant area, the proposed transmission line route, and the alternative transmission line segments. The majority of these roads are located on either the Klamath or Modoc National Forests. However, other major arterials that extend beyond these Forests are also discussed.

METHODOLOGY

Existing USFS and USGS maps were reviewed to identify regional transportation and access routes on the Klamath and Modoc National Forests. Site visits were conducted to examine traffic conditions along these routes, and to verify existing access roads in the vicinity of the proposed project and project alternatives.

REGIONAL OVERVIEW

Regional Access Routes

Access in the project region is provided by the highways identified below and illustrated in Figure 2.2-1.

- Interstate 5 (I-5), which is a major north-south arterial located approximately 40 miles west of the proposed plant site, and which extends from central California north into Oregon
- Highway 97, which extends northeast from I-5 (at Weed) to Dorris and points further north in Oregon
- Highway 89, which extends southeast from I-5 (at Mt. Shasta) to McCloud and points further southeast
- Highway 139, which extends southeast from the California-Oregon border to Canby and points further south

I-5 is generally a four-lane, limited-access freeway that serves as the primary access route between California and Oregon. The other regional highways serve more local traffic; these highways are generally paved, two-lane routes with pull-out lanes on steep inclines and turn lanes at major intersections and crossroads. Typical of highways in rural, low population density areas, traffic volumes on these highways are generally very low. Traffic delays can occasionally occur due to road construction activities along these routes. Due to the variety of recreational uses (such as camping, boating, and hunting) that occur in the region, traffic volumes tend to be slightly higher during the summer months when these activities are occurring than during the winter months.

Project Vicinity Roads

The project area is located entirely on National Forest lands, and roads in the immediate project vicinity are either forest roads or county roads. The vicinity of the proposed action is well accessed by several existing paved and gravel-surfaced arterial roads, as

well as many gravel-surfaced collector roads. Traffic volumes in the vicinity are very low and are typical of rural areas with sparse populations. Travel on vicinity roads occurs primarily during the summer months since this is the period of highest forest use. Project vicinity roads are generally closed during the winter months due to snow conditions. The primary access routes in the vicinity are identified below and illustrated in Figure 2.2-2.

- Medicine Lake Highway (Modoc County Road/Primary Forest Route 97) is a paved two-lane arterial that extends west from Highway 139 near Tionesta to Medicine Lake
- Primary Forest Route 49 is a partially paved, partially gravel-surfaced, primarily single-lane arterial with turn-outs that extends south from Lava Beds National Monument past Medicine Lake to Highway 89
- Primary Forest Route 15, also known as Davis Road, is a paved two-lane arterial that extends southeast from Macdoel (at Highway 97) to the vicinity of Medicine Lake, and then heads southwest from the Medicine Lake area to Highway 89
- Primary Forest Route 77 (45N50) is a partially paved, partially gravel-surfaced, two-lane arterial that extends east from Highway 97 past Primary Forest Route 15 to the vicinity of Medicine Lake

In the immediate vicinity of Medicine Lake, the USFS has paved some roads (such as Forest Road 43N48, which runs along the northern shore of Medicine Lake) in order to better accommodate recreational traffic. However, these roads have received only a thin surface pavement, and are not designed to handle heavy loads such as logging or water trucks. The USFS is concerned that heavy truck loads could break up and destroy the pavement along these roads (BLM et al. 1995).

In addition to the roads described above, several gravel-surfaced roads and unimproved dirt access and spur roads criss-cross the project vicinity. These roads have been established primarily to support timber harvest activities and to provide access to more remote parts of the Forest. USFS personnel frequently use these roads, as do hunters, campers, and other recreationalists. Geothermal exploration companies have also used these roads to access existing geothermal well pads, which are often located in logged areas.

PROPOSED ACTION (ALTERNATIVE 1)

Wellfield and Power Plant Area Access

Access to the Wellfield and Power Plant Area: The proposed wellfield and power plant area can be accessed from points east, north, west, and south. Existing access routes to the proposed wellfield and power plant area are illustrated in Figure 2.2-2.

From points east (such as Highway 139 and Tionesta), existing access to the proposed wellfield and power plant area is primarily provided via Primary Forest Routes 97 and 49. The wellfield and power plant area can be accessed by following Primary Forest Route 97 from Highway 139 near Tionesta to a "T" intersection with Primary Forest Route 49 near Medicine Lake. Route 49 can then be followed north past Medicine Lake and the Medicine Lake Lava Flow to an existing spur road in Section 28. This spur road extends approximately 850 feet to the proposed power plant site, where an existing geothermal exploration well pad is located.

An alternate route to the proposed wellfield and power plant area from points east follows Primary Forest Route 10, Forest Road 44N22, and Primary Forest Route 49. Route 10 begins at an intersection with Primary Forest Route 97 near Tionesta. This route heads generally northwest to an intersection with Forest Road 44N22, about one mile south of the Lava Beds National Monument. Forest Road 44N22 then heads west for about six miles to an intersection with Primary Forest Route 49, which can be followed southwest past the Door Knob Snowmobile Park for about seven miles to the existing spur road to the proposed plant site.

From points north, Primary Forest Route 49 is the primary existing access route to the proposed wellfield and power plant area. This access route passes through the Lava Beds National Monument before reaching the Modoc National Forest (see Figure 2.2-2). As described above, this route heads southwest in the vicinity of the proposed action to the existing spur road to the proposed plant site. In order to avoid traffic impacts to Lava Beds National Monument, the proposed project would not use this access route.

From points west and northwest, Primary Forest Routes 15 and 77 and a variety of Forest Roads provide the primary existing access to the proposed wellfield and power plant area (see Figure 2.2-2). Either Route 15 or 77 can be used to access the Fourcorners-Medicine Lake Snowmobile park, which is located about seven miles northwest of Medicine Lake. At this location, there are three primary routes that could be followed to access the wellfield and power plant area:

- Route 77 could be followed south until it branches east towards Medicine Lake. This portion of Route 77, which is also identified as Forest Road 44N50, terminates at an intersection with Primary Forest Route 49. Route 49 could then be followed north for about 0.5 miles to the existing spur road to the proposed plant site.
- Route 77 could be followed south and then east to the intersection with Forest Road 44N54, which could be followed northeast to the wellfield area in Section 28.
- Forest Road 44N01 could be followed northeast for about seven miles to an intersection with Forest Road 44N64 about two miles north of Lookout Butte. Road 44N64 could then be followed south for about three to four miles to the wellfield area in Section 28.

The route following Forest Road 44N01 northeast to Forest Road 44N64 would be the primary access route to the power plant and wellfield area throughout the proposed project, and it would be the only access route used during the winter. Current traffic volumes on these two roads range between 10 and 20 trips per day (USFS 1997).

Primary Forest Route 49 is the primary existing access route to the proposed wellfield and power plant area from points south (see Figure 2.2-2). This route extends north from Highway 89 through the Shasta-Trinity and Modoc National Forests to the vicinity of Medicine Lake. As described above, Primary Forest Route 49 can be followed north past Medicine Lake and the Medicine Lake Lava Flow to the existing spur road to the proposed plant site.

Roads within the Wellfield and Power Plant Area: As illustrated in Figure 2.2-3, there are several existing unpaved and gravel roads within the proposed wellfield and power plant area. Forest Road 44N54 is oriented in an east-to-west direction in the wellfield and power plant area; this road extends across the northern portion of Section 28. Forest

Road 44N64 enters the wellfield and power plant area from the north, and terminates at an intersection with Forest Road 44N54 near the center of Section 28. The remainder of the existing routes in the wellfield and power plant area are undesignated roads.

Transmission Line Route Access

The proposed transmission line route (i.e., transmission line segments A1, A2, B1, and C1) can generally be accessed by existing roads at various points along most of its length. Primary direct access to the proposed route occurs at locations where the proposed alignment crosses existing roads, as discussed below by segment. Unless otherwise specified, all access points identified provide existing access to, but not along, the proposed transmission line route.

Segment A1: Existing access to segment A1 is provided in three primary locations where the proposed transmission line route crosses existing roads in the Medicine Lake area:

- Primary Forest Route 49, just north of Medicine Lake
- Primary Forest Route 77, near Grouse Hill
- An unnamed paved road off of Forest Road 43N48, which provides access between Little Medicine Lake and the Medicine Lake Lava Flow

Segment A2: Existing access to segment A2 is provided primarily from Forest Road 43N53. The proposed route alignment crosses this road at the southern end of segment A2. Forest Road 43N53 provides secondary access between Primary Forest Routes 49 and 97, with connections to the Lyons Peak Loop Road (Forest Road 44N99). A gated spur road is located at the southern end of segment A2 along Forest Road 43N53. This spur road heads northeast along the southeastern flank of Mount Hoffman to an existing geothermal well pad (28-32). The southern half of segment A2 would generally parallel this spur road. The remaining portion of segment A2 would pass through the Mount Hoffman released roadless area; this area does not have existing road access.

Segment B1: An unnamed, paved forest road generally parallels the full length of segment B1, crossing this segment in one location. This road provides a loop access, off of Forest Road 44N01, to pumice mines located along the northern edge of the Glass Mountain Lava Flow. Forest Road 44N01 also crosses the proposed route alignment along segment B1 along its eastern end.

Segment C1: Existing access to segment C1 is provided in three primary locations where the proposed route alignment crosses existing roads in the Tionesta area:

- State Highway 139
- Primary Forest Route 97, just north of Tionesta
- Primary Forest Route 10, just northwest of Tionesta

There are also several unimproved, unnamed roads that cross segment C1.

ALTERNATIVES

As discussed at the beginning of this chapter, the following discussion describes the affected environment for each alternative to the proposed action. Alternatives to the

proposed action include various alternate transmission line routes (Alternatives 2 through 6) and the No Action alternative (Alternative 7).

For Alternatives 2 through 6, the affected environment for the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of the existing environment along these portions of the transmission line are not repeated under each alternative discussion. The description of the affected environment for these alternatives focuses on those segments of the transmission line that would be different from those in the proposed action, and provides references for those segments that have been previously discussed under the proposed action or a preceding alternative discussion. For Alternative 7, no discussion is provided in this Chapter since there would be no affect on the environment under this alternative.

Alternative 2 (Segments A1, A2, B1, and C2)

Existing access to the proposed wellfield and power plant area is the same as described above for the proposed action (Alternative 1) because the wellfield and power plant area would occur on the same site as identified for the proposed action. The transmission line route under Alternative 2 would utilize segments A1, A2, B1, and C2. Access to the transmission line route under Alternative 2 is the same as described above for the proposed action (Alternative 1) related to segments A1, A2, and B1. Existing access to segment C2 is described below.

Segment C2: Existing access to segment C2 is provided in three primary locations where the proposed route alignment crosses existing roads north of Tionesta, near the Dry Lake area:

- State Highway 139
- Primary Forest Route 10
- Forest Road 45N32

Forest Road 45N32 parallels segment C2 in the Dry Lake area and crosses this segment in several locations.

Alternative 3 (Segments A1, B2, and C1)

Existing access to the proposed wellfield and power plant area is the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area would occur on the same site as identified for the proposed action. The transmission line route under Alternative 3 would utilize segments A1, B2, and C1. Access to the transmission line route under Alternative 3 is the same as described above for the proposed action (Alternative 1) related to segments A1 and C1. Existing access to segment B2 is described below.

Segment B2: Existing access to segment B2 is provided at various locations along this route alignment where the alignment crosses or is adjacent to existing roads. From its eastern endpoint near Arnica Sink, this segment extends generally southeast along Forest Road 43N53. At the intersection of Forest Road 43N53 and Primary Forest Route 97, segment B2 generally follows Primary Forest Route 97 east out of the Medicine Lake

Highlands to the Modoc Plateau area. Once segment B2 reaches the Modoc Plateau, it diverges from Primary Forest Route 97. In this area, several unimproved, unnamed roads provide access to the segment B2 alignment.

Alternative 4 (Segments A1, B2, and C2)
Existing access to the proposed wellfield and power plant area is the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area would occur on the same site as identified for the proposed action. The transmission line route under Alternative 4 would utilize segments A1, B2, and C2. Access to the transmission line route under Alternative 4 is the same as described above for the proposed action (Alternative 1) related to segment A1. Existing access along segment B2 is the same as described above for Alternative 3. Existing access along segment C2 is the same as described above for Alternative 2.

Alternative 5 (Segments A3, B1, and C1)
Existing access to the proposed wellfield and power plant area is the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area would occur on the same site as identified for the proposed action. The transmission line route under Alternative 7 would utilize segments A3, B1, and C1. Access to the transmission line route under Alternative 7 is the same as described above for the proposed action (Alternative 1) related to segments B1 and C1. Existing access along segment A3 is described below.

Segment A3: Existing access to segment A3 is provided where this segment crosses Forest Road 44N54 and where it crosses Primary Forest Route 49. Near Fourmile Hill, Forest Road 44N64 parallels segment A3 to the west, but does not cross the segment at any point. An unnamed spur road that extends from Forest Road 44N54 north to the top of Fourmile Hill parallels a portion of segment A3 to the east, but does not cross the segment at any point. Several unimproved, unnamed spur roads off of Forest Road 44N01 also cross segment A3; these spur roads are located mostly along the eastern portion of this segment.

Alternative 6 (Segments A3, B1, and C2)
Existing access to the proposed wellfield and power plant area is the same as described above for the proposed action (Alternative 1) as the wellfield and power plant area would occur on the same site as identified for the proposed action. The transmission line route under Alternative 6 would utilize Segments A3, B1, and C2. Access to the transmission line route under Alternative 3 is the same as described above for the proposed action (Alternative 1) related to Segment B1. Existing access along Segment C2 is the same as described above for Alternative 2. Existing access along Segment A3 is the same as described above for Alternative 5.

Alternative 7 (No Action)
The setting for Alternative 7, the No Action alternative, would be the same as for Alternatives 1 through 6.

3.13 Air Quality

STUDY AREA

The study area for the air quality analysis of the proposed project included the area encompassing the proposed wellfield and power plant site, and the proposed and alternative transmission line routes. These facilities extend approximately from Grouse Hill on the west to the BPA Malin-Warner transmission line on the east (Figure 2.2-2). The study area also includes the larger region, due to public concerns about the potential air quality effects of the proposed action. Surrounding locations that are considered within the study area include the Lava Beds National Monument, the closest Class I airshed, and surrounding communities such as Tionesta, Dorris, and Tulelake.

REGIONAL OVERVIEW

Air Basin Characteristics

The Glass Mountain Known Geothermal Resource Area (KGRA) lies within the Northeast Plateau Air Basin which extends from the Nevada border on the east to Siskiyou Mountains in the west, and from the Oregon border to the southern border of Lassen County. The air basin includes all of Lassen, Siskiyou and Modoc Counties. The total area of the air basin is 14,920 square miles or about 9.5 percent of the area of California and is the fourth largest air basin in the state. The project is located in eastern Siskiyou County, one of the three counties that comprise the air basin. The setting for the project is rural with no substantial air pollution sources other than fugitive dust from agricultural and recreational activities.

From a climate and air quality perspective, the major topographic features are the Medicine Lake caldera (the proposed site of the wellfield power plant area is located on the northeast flank of the caldera), and the Modoc Plateau, which is an extensive volcanic tableland situated east of the Cascade Range. The Cascade Range is not a continuous high barrier but, rather, isolated peaks of volcanic origin aligned in a north-south chain. The Medicine Lake caldera and Mt. Shasta to the east are two major features of the Cascades. There is considerable variation in climate from the south-facing slopes of the caldera to the Tulelake basin on its lee side.

Climate and Meteorology

Overview: Weather in Northern California is dominated by the position of the eastern Pacific High pressure cell normally located off the coast of North America. During the winter months this meteorological feature typically is positioned to result in an almost unbroken succession of winter storms within the study area. In fact, the mean storm track of Pacific storms during the winter passes through northern California and southern Oregon. As a consequence, the bulk of precipitation in the project area occurs during this winter storm period. Weather systems are generally accompanied by good dispersion conditions (i.e., strong winds and unstable air mass). During fair weather periods the atmosphere stabilizes and wind speeds are reduced. However, at the elevation of the proposed wellfield and power plant site, regional stagnation is uncommon although terrain-induced features could produce local stagnation and trapping of pollutants.

The major large-scale meteorological feature occurring in spring is movement of the Pacific High to the north, which correspondingly shifts the tracks of storms; precipitation in the study area declines as a result. However, rarely is the spring weather warm and dry. Significant precipitation continues and temperatures remain cool throughout the spring. A common occurrence during the spring months is the incursion of cold unstable air from the North Pacific causing brief periods of intense rain and snow often accompanied by thunderstorms.

As the Pacific High continues to shift northward, influences from organized frontal systems coming off the Pacific decrease to negligible during the summer months. The climate becomes dry and temperatures increase, although afternoon thundershowers are not uncommon. According to a California Air Resources Board (CARB) report thunderstorms occur over the Modoc Plateau on 20 percent of the days (Gibson 1974); this is consistent with observations taken by the National Weather Service at Klamath Falls.

The last half of September through October is typically a transition period between the dry summer and wet winter conditions. Generally weather conditions are dominated by clear cool days with temperatures at night falling below freezing. In some years, snowpack can begin accumulating in the study area by mid-October.

Precipitation: In Table 3.13-1, average monthly precipitation amounts are given for McCloud Ranger Station, located southwest of the project area at an elevation of 3,279 feet in the McCloud River drainage, and Tulelake Ranger Station north of the project area at an elevation of 4,042 feet. Precipitation amounts vary significantly between the two sites due to topographic influences. Although total amounts vary significantly between these two sites, the McCloud data show that two-thirds of the annual precipitation occurs during the December to March period, whereas at Tulelake less than half of the annual total occurs during the same period. Precipitation is more evenly distributed throughout the year at Tulelake, which is located on the Modoc Plateau. Extremes at McCloud during the winter range from more than 33 inches of precipitation in January 1995 (versus approximately 3 inches during the corresponding period at Tulelake) to less than 1 inch in December 1990. Significant amounts of precipitation occur in the fall and spring that can take the form of rain or snow (or hail) at these two sites.

There are no reliable daily or monthly precipitation records within the study area. Precipitation amounts are likely between the levels recorded at the McCloud and Tulelake Ranger Stations, identified in Table 3.13-1, but probably more similar to McCloud. In all but extreme instances of storms with high freezing levels, precipitation at the wellfield and power plant area during the winter is in the form of snow. Snow course measurements are taken once a year at the beginning of April in a meadow adjacent to the Medicine Lake Ranger station. Those measurements for the 20-year period (1977 to 1996) are shown in Figure 3.13-1. Both snow depth and the water equivalent of the snow pack are shown. Snow depth extremes range from a minimum of approximately 27 inches in 1988 to nearly 160 inches in 1983. The water equivalent was 65 inches in 1983. This snow depth and water equivalent information is considered to be representative of the likely and variable conditions of the proposed wellfield and power plant site.

Table 3.13-1: Average Monthly and Diurnal Precipitation

	McCloud Ranger Station[1] Monthly		Tulelake[2] Monthly	
Month	**Average**	**Maximum**	**Average**	**Maximum**
October	2.01	8.46	0.50	1.17
November	3.00	10.26	1.02	2.36
December	6.19	14.72	1.16	4.08
January	9.14	33.11	1.45	2.64
February	4.23	12.87	0.97	2.98
March	9.14	20.22	1.42	3.68
April	3.25	8.11	0.87	1.84
May	3.86	10.72	1.21	1.94
June	1.34	4.10	0.83	1.84
July	0.13	0.36	0.47	2.60
August	0.27	1.10	0.31	1.53
September	0.51	2.94	0.40	1.44
Water Year Annual	43.07		10.61	

Notes:

[1] Period of Record 1988-96

[2] Period of Record 1985-96

SOURCE: California Department of Water Resources, Division of Flood Management

Temperature and Humidity

Continuous measurements of ambient temperature and relative humidity were made at the proposed power plant site during the period from mid-November 1994 to mid-November 1995 (Lehrman 1996a). The annual variation in these two parameters can be seen from the data in Table 3.13-2. Average hourly temperature and relative humidity and average daily maximum and minimum temperatures are compiled in this table.

The data show a typical annual variation with minimum temperatures occurring in the December to January period, and the maximum variation experienced in the July to August period. Temperatures were warmer in February than in adjacent months, which corresponded to an atypical fair weather period in which record low precipitation amounts were reported in northern California. In the preceding three months (November to January), the average daily maximum temperature was below freezing. Moreover, minimum temperatures were generally below or near freezing for eight months. Temperatures in November 1995 were dramatically warmer (16 °F average) than in November 1994. Record high temperatures were experienced throughout northern California in November 1995.

Table 3.13-2: Monthly Ambient Temperature and Relative Humidity Summary

Month-Year	Average Hourly Temp (°F)		Average Hourly Rh (%)		Average Daily Max Temp (°F)		Average Daily Min Temp (°F)	
Nov-94	22.0	(388)	85	(388)	28.2	(17)	15.3	(17)
Dec-94	24.3	(744)	83	(744)	30.4	(31)	18.1	(31)
Jan-95	27.4	(647)	95	(647)	30.1	(28)	24.8	(28)
Feb-95	33.8	(672)	64	(672)	46.7	(28)	24.0	(28)
Mar-95	27.1	(744)	84	(744)	34.4	(31)	20.0	(31)
Apr-95	31.6	(720)	78	(720)	41.7	(30)	21.3	(30)
May-95	39.9	(744)	72	(744)	51.7	(31)	28.8	(31)
Jun-95	44.3	(720)	74	(720)	55.7	(30)	33.7	(30)
Jul-95	54.8	(744)	61	(744)	67.3	(31)	41.2	(31)
Aug-95	54.6	(742)	49	(742)	68.6	(31)	39.1	(31)
Sep-95	51.9	(720)	53	(720)	65.7	(30)	39.2	(30)
Oct-95	42.2	(744)	56	(744)	55.0	(31)	30.3	(31)
Nov-95	38.0	(398)	71	(398)	47.1	(17)	30.7	(17)

Notes:
°F - Degrees Fahrenheit
Rh - Relative humidity.
Sample size shown in parenthesis.

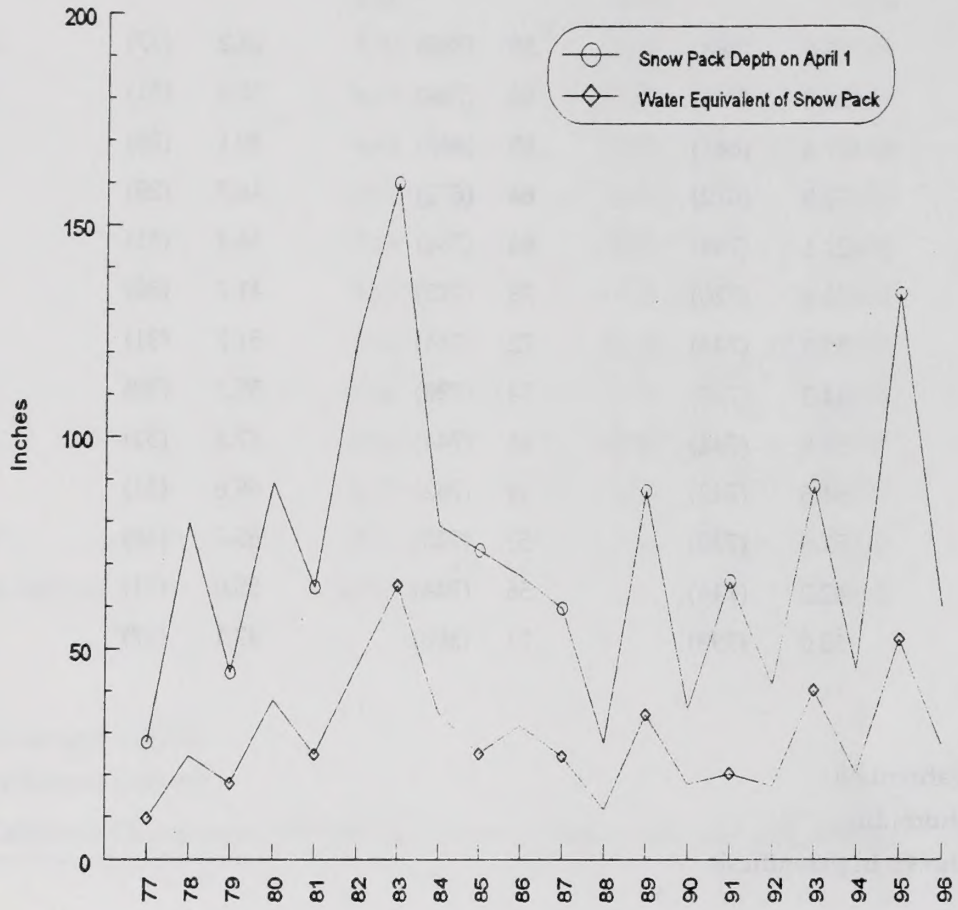
SOURCE: Lehrman 1996a

Minimum relative humidities occurred in late summer and early fall (August to October). Relative humidities in February are somewhat anomalous due to the extended period of fair weather.

Regional and Local Winds

Regional Winds: The regional wind conditions were measured during the same one-year period (mid-November 1994 to mid-November 1995) when temperature and humidity were monitored at the proposed power plant site. The regional wind monitoring occurred at Red Shale Butte, which is located approximately 6 miles southeast of the power plant site on top of a prominent peak (Lehrman 1996b). This site was selected for meteorological monitoring because local terrain should have only a minimal influence, so measurements should be representative of regional conditions.

Figure 3.13-1: Medicine Lake Snow Course Measurements, 1977 to 1996



Prevailing winds at Red Shale Butte were from the southwest, based on the annual windrose, which combines all hours of the day for the entire period of record, is shown in Figure 3.13-2. Winds with an easterly component were infrequent. The most striking feature of the Red Shale wind measurements is the high wind speeds. The most frequent wind speed range was approximately 6 to 9 meters per second (m/sec) with numerous measurements of wind speeds in exceedance of 10 m/sec. Only 13 hours of calm winds (<1 m/sec) occurred over the one-year period.

Site-specific Winds: Measurements of wind, temperature, humidity, and solar radiation were taken at the power plant site for the same one-year period (mid-November 1994 to mid-November 1995) as Red Shale Butte.

The winds on an annual basis at the power plant site do not show any evidence of significant local terrain-driven slope flows—a feature commonly present in complex terrain. Prevailing winds at that site were from the south-southwest (16%) and south (14%). Winds with a southerly component occurred 65% of the time over the one year period. The annual windrose for the power plant site is shown in Figure 3.13-3.

The most frequent (mode) hourly-averaged wind speeds were in the 2 to 4 m/sec range. The few instances of wind speeds greater than 6 m/sec occurred when the direction was from one of the two prevailing direction categories. Winds with a northerly component were generally light (<2 m/sec). It should be noted that when the wind at the power plant site has a northerly component, the speed could have a bias to lower magnitudes due to less than optimum exposure. Calm winds or wind speeds less than 1 m/sec occurred 6% of the time.

The annual wind direction frequencies discussed above are generally reflected in the transitional (fall and spring) seasons at wellfield and power plant site. During the winter months (December to February), the winds in 1994-95 were overwhelmingly (70%) from the south-southwest through southeast due to the high number of weather systems passing through Northern California. The strongest winds observed were associated with their passage. A number of well-developed weather systems in the area continued to have a significant effect on the wind statistics in the first half of spring (March to May) and strong southerly winds were frequent in those months as well. During the summertime, the most striking feature of the winds is the preponderance of low speeds. Winds less than 2 m/sec in magnitude occurred more than 64% of the time. This was also true during the fall (September to November) period. Appendix E, Figures 1 through 4 show seasonal windroses for the power plant site.

Local terrain-induced winds from slope heating and cooling are most pronounced during the summertime when insulation is greatest, and clear skies prevail at night maximizing radiation cooling. Windroses for six-hour periods during June to August are shown in Appendix E, Figures 5 through 8. The four six-hour periods shown are early morning, before sunrise (00-05), mid-morning (06-11), afternoon (12-17), and evening (18-23) Pacific Standard Time (PST). Downslope (katabatic) flows are typically strongest during the 00-05 PST period, and upslope flows, due to the slope heating by insolation, are strongest during the afternoon (12-17 PST) period. The 06-11 and 18-23 PST times are transitional periods between the two flow regimes.

Figure 3.13-2: Wind Frequency Distribution for Red Shale Butte from October 1994 through October 1995 - All Hours

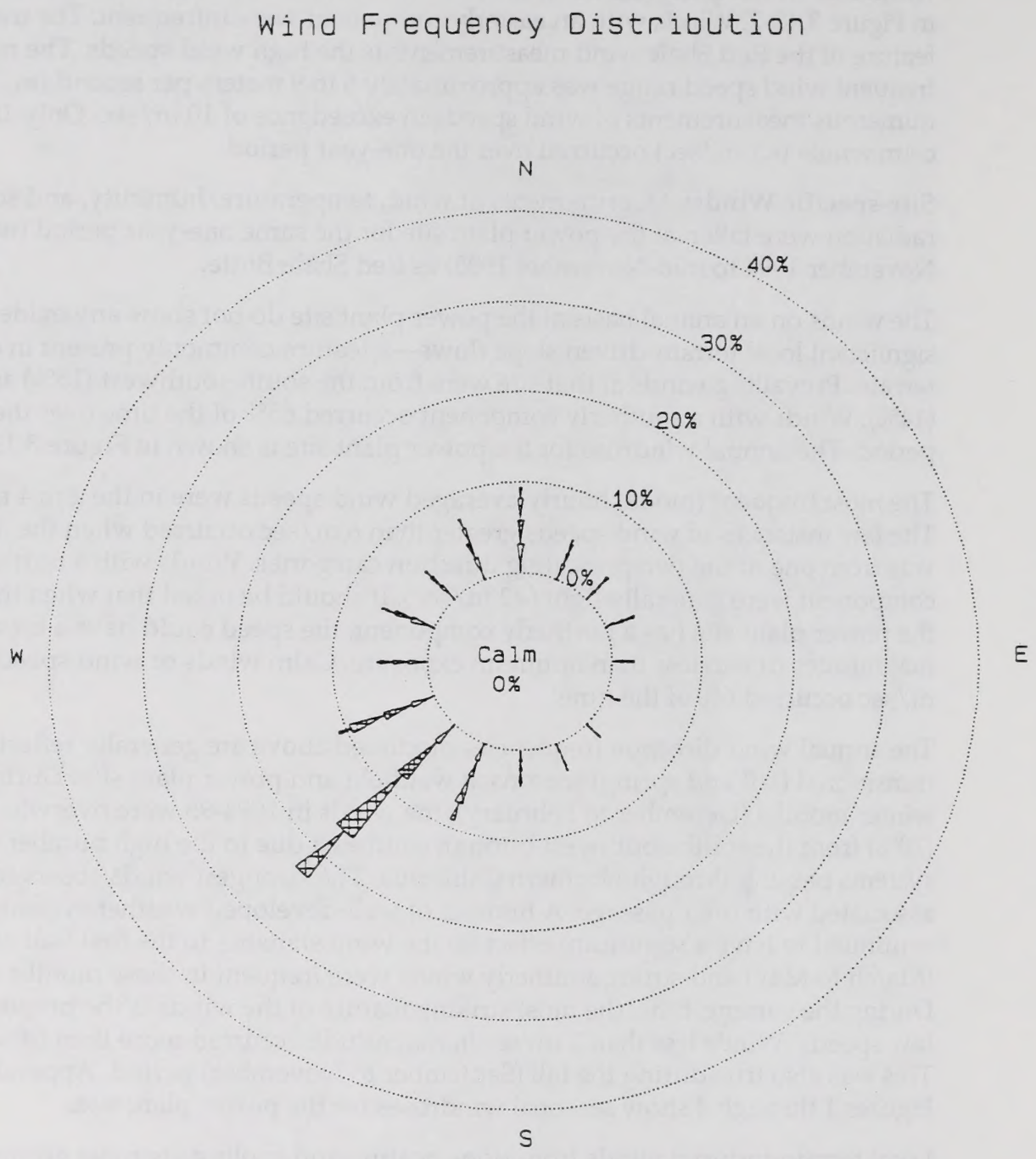
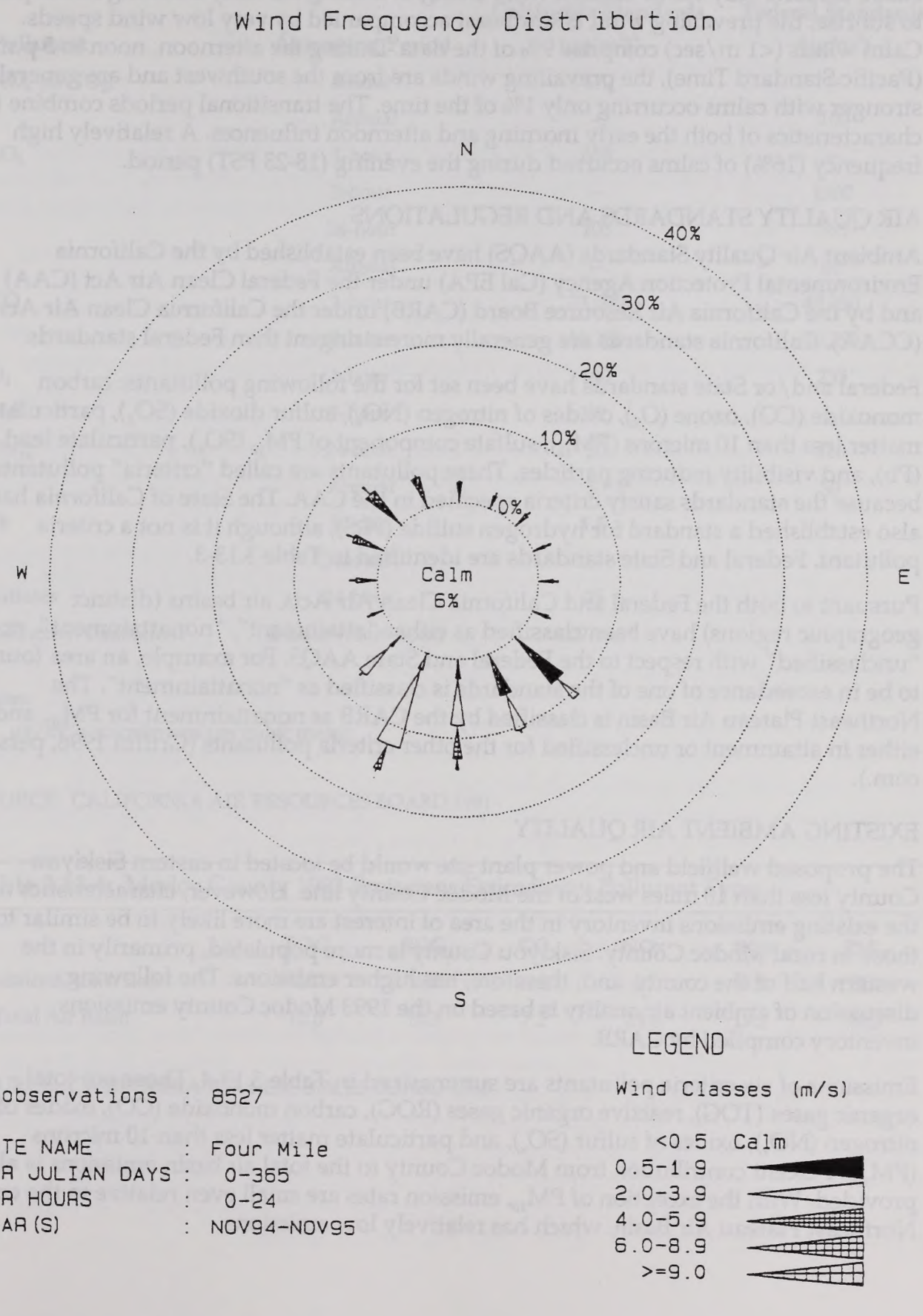


Figure 3.13-3: Wind Frequency Distribution for Fourmile Hill from November 1994 through November 1995 - All Hours



The wellfield and power plant site, because of its location in terrain above the caldera basin, exhibits only subtle diurnal wind changes. During the early morning hours prior to sunrise, the prevailing wind is southeast accompanied by very low wind speeds. Calm winds (<1 m/sec) comprise 9% of the data. During the afternoon, noon to 5 p.m. (Pacific Standard Time), the prevailing winds are from the southwest and are generally stronger with calms occurring only 1% of the time. The transitional periods combine the characteristics of both the early morning and afternoon influences. A relatively high frequency (16%) of calms occurred during the evening (18-23 PST) period.

AIR QUALITY STANDARDS AND REGULATIONS

Ambient Air Quality Standards (AAQS) have been established by the California Environmental Protection Agency (Cal EPA) under the Federal Clean Air Act (CAA) and by the California Air Resource Board (CARB) under the California Clean Air Act (CCAA). California standards are generally more stringent than Federal standards.

Federal and/or State standards have been set for the following pollutants: carbon monoxide (CO), ozone (O_3), oxides of nitrogen (NO_x), sulfur dioxide (SO_2), particulate matter less than 10 microns (PM_{10}), sulfate component of PM_{10} (SO_4), particulate lead (Pb), and visibility reducing particles. These pollutants are called "criteria" pollutants because the standards satisfy criteria specified in the CAA. The State of California has also established a standard for hydrogen sulfide (H_2S), although it is not a criteria pollutant. Federal and State standards are identified in Table 3.13-3.

Pursuant to both the Federal and California Clean Air Acts, air basins (distinct geographic regions) have been classified as either "attainment", "nonattainment", or "unclassified" with respect to the Federal and State AAQS. For example, an area found to be in exceedance of one of the standards is classified as "nonattainment". The Northeast Plateau Air Basin is classified by the CARB as nonattainment for PM_{10}, and is either in attainment or unclassified for the other criteria pollutants (Griffin 1996, pers. com.).

EXISTING AMBIENT AIR QUALITY

The proposed wellfield and power plant site would be located in eastern Siskiyou County less than 10 miles west of the Modoc County line. However, characteristics of the existing emissions inventory in the area of interest are more likely to be similar to those in rural Modoc County. Siskiyou County is more populated, primarily in the western half of the county, and, therefore, has higher emissions. The following discussion of ambient air quality is based on the 1993 Modoc County emissions inventory compiled by CARB.

Emissions of six criteria pollutants are summarized in Table 3.13-4. Those are total organic gases (TOG), reactive organic gases (ROG), carbon monoxide (CO), oxides of nitrogen (NO_x), oxides of sulfur (SO_x), and particulate matter less than 10 microns (PM_{10}). Percent contribution from Modoc County to the total air basin emissions is also provided. With the exception of PM_{10}, emission rates are small even relative to the entire Northeast Plateau Air Basin, which has relatively low emissions.

Table 3.13-3: State and Federal Ambient Air Quality Standards

Pollutant	Averaging Period	California Standards ($\mu g/m^3$)[1]	Federal Standards ($\mu g/m^3$)
NO_x (as NO_2)	1-hour	470	--
	Annual	--	100
SO_2	1-hour	655	--
	3-hour	--	1300
	24-hour	105	365
	Annual	--	80
CO	1-hour	23,000	40,250
	8-hour	10,350	10,350
O_3	1-hour	180	235
H_2S	1-hour	42	--
PM_{10}	24-hour	50	150
	Annual	30	50
Pb	30-day	1.5	--
	Quarterly	--	1.5
Sulfates	24-hour	25	--
Extinction Coefficient	8-hour (10am-6pm)	0.07 km^{-1}	--

Notes:

[1] $\mu g/m^3$ = micrograms per cubic meter

SOURCE: CALIFORNIA AIR RESOURCES BOARD 1991

Table 3.13-4: Modoc County 1993 Emissions Estimate by Pollutant Type

	TOG	ROG	CO	NOx	SOx	PM_{10}
Emissions, tons/day	4.9	4.1	26.0	4.7	0.5	27.0
% Total Air Basin	10.0	10.3	7.2	13.8	17.2	22.5

SOURCE: CALIFORNIA AIR RESOURCES BOARD 1995

The major contributors to PM_{10} emissions are, in decreasing order:

- Entrained dust from unpaved roads (16 tons/day)
- Farming operations (4.5 tons/day)
- Entrained dust from paved roads (1.7 tons/day)
- Fugitive windblown dust (1.7 tons/day)

These four sources make up 92% of the estimated emissions of primary particulate. Waste burning for forest and range management, recreational campfires, and wild fires are other likely significant contributors to particulate concentrations in the project area.

It should be noted that Klamath Falls, approximately 40 miles north of the proposed project, has produced enough PM_{10} emissions to violate the Federal ambient air standard of 150 micrograms per cubic meter ($\mu g/m^3$) during wintertime stagnation periods. Particulate emissions in that area are attributed mainly to woodsmoke pollution; however, there have been no violations of the PM_{10} standard since 1992.

Gaseous Pollutants

The Northeast Plateau Air Basin is in compliance with the California Clean Air Act for all gaseous pollutants. The air basin is classified as an attainment area for O_3 and NO_x, and unclassified with regard to SO_2 and H_2S (Griffin 1996, pers. com.).

Background levels for the gas criteria pollutants are not readily available for the project area. The only gaseous pollutant monitored within the past five years in the Northeast Plateau Air Basin was ozone at Yreka, a location not representative of conditions in the project area. Ozone levels are routinely monitored in the Lassen Volcanic National Park where it is reasonable to assume that terrain, climate, and land use are similar to those in the project area. The 1991 to 1995 measurements are summarized by season and annually in Table 3.13-5. Nitrogen dioxide (NO_2), SO_2, and CO measurements are routinely made in urban settings or known receptor areas and, as a consequence, levels representative of what would likely be experienced in the project area were not available. The concentrations shown in Table 3.13-5 are estimates based on there being no existing stationary or mobile sources in or near the project area.

Particulate Matter

The current standards for PM_{10} concentrations are 50 $\mu g/m^3$ and 150 $\mu g/m^3$ over a 24-hour period, for the State and Federal CAAs respectively. Typically, a particulate sample is taken during one 24-hour period every six days. Routine (year around) PM_{10} measurements are conducted by the Siskiyou County APCD at four sites in the Northeast Plateau Air Basin, of which only data collected from the Lava Beds National Monument site are relevant to the study area. Measurements at the Lava Beds Visitor Center started in 1994. The District made supplemental measurements at Medicine Lake (Guard Station) during the summer in 1995 and 1996, and at the power plant site during the summer in 1996. Those measurements are summarized in Table 3.13-6. The total number of PM_{10} samples taken at each of the three sites and the annual average concentrations are provided in this table. The number of samples having PM_{10} levels greater than 25 $\mu g/m^3$ and 50 $\mu g/m^3$ (state standard) is shown.

Table 3.13-5: Background Concentrations of Gas Criteria Pollutants

Pollutant	Hourly Average Concentration		Data Source
	Period	Mean/ Maximum	
O_3[a]	Dec-Feb	42/65 ppb	Lassen NP/CARB
	Mar-May	50/85 ppb	Lassen NP/CARB
	Jun-Aug	58/93 ppb	Lassen NP/CARB
	Sep-Nov	47/89 ppb	Lassen NP/CARB
	Annual	50/93 ppb	Lassen NP/CARB
H_2S[b]	Annual	<1/- ppb	Project Area/Measurements

Notes:

[a] 1991-1995

[b] Jul-Sep 1996 period

ppb = parts per billion

SOURCE: Lassen Volcanic National Park 1991 and 1995 monitoring data, and T&B Systems 1996.

No exceedances of the State (or Federal) standard were experienced at any of the sites. Nearly one-half of the samples taken at Medicine Lake exceeded 25 $\mu g/m^3$ due largely to the site's proximity to several heavily-used campgrounds. The highest particulate loading in 1996 was experienced from August 14 to September 5 when the area was impacted by smoke from a large fire in the Mendocino National Forest approximately 175 miles away (Griffin 1996, pers. com.).

Particulate Lead and Sulfate

The particulate species lead and sulfate are criteria pollutants as well. The state standard is 1.5 $\mu g/m_3$ 30-day average for lead and 25 $\mu g/m^3$ 24-hour average for sulfate PM_{10} mass. The Federal standard for lead is 1.5 $\mu g/m^3$ quarterly average. There is no Federal standard for sulfates.

The most representative (from a location standpoint) particulate matter data that is routinely analyzed for its chemical composition is from Lassen Volcano National Park (Lava Beds National Monument data is total mass only). The National Park Service and University of California at Davis, Crocker Nuclear Lab provided data for the period December 1991 to November 1995. Maximum 30-day and quarterly lead concentrations during that period of record were less than 0.001 $\mu g/ m^3$. The maximum 24-hour sulfate concentration was 2.3 $\mu g/ m^3$. It should be noted that the National Park Service/ U.C. Davis analyses are performed on the $PM_{2.5}$ mass only. There has been no attempt to adjust the concentrations to PM_{10}.

Table 3.13-6: PM_{10} Concentrations in or Near the Project Area

	Total Samples Taken	Average of Samples	>25 μg/m³	>50 μg/m³
1994	30	10.9	2	0
Lava Beds	0	-	-	-
Medicine Lake Power Plant[a]	0	-	-	-
1995	51	8.6	1	0
Lava Beds	7	23.5	2	0
Medicine Lake Power Plant	0	-	-	-
1996 (through September)	38	8.9	0	0
Lava Beds	17	22.2	9	0
Medicine Lake Power Plant	16	16.8	2	0

[a] Proposed Location

SOURCE: Siskiyou County APCD Monitoring Data (Lava Beds National Monument) 1994-1996

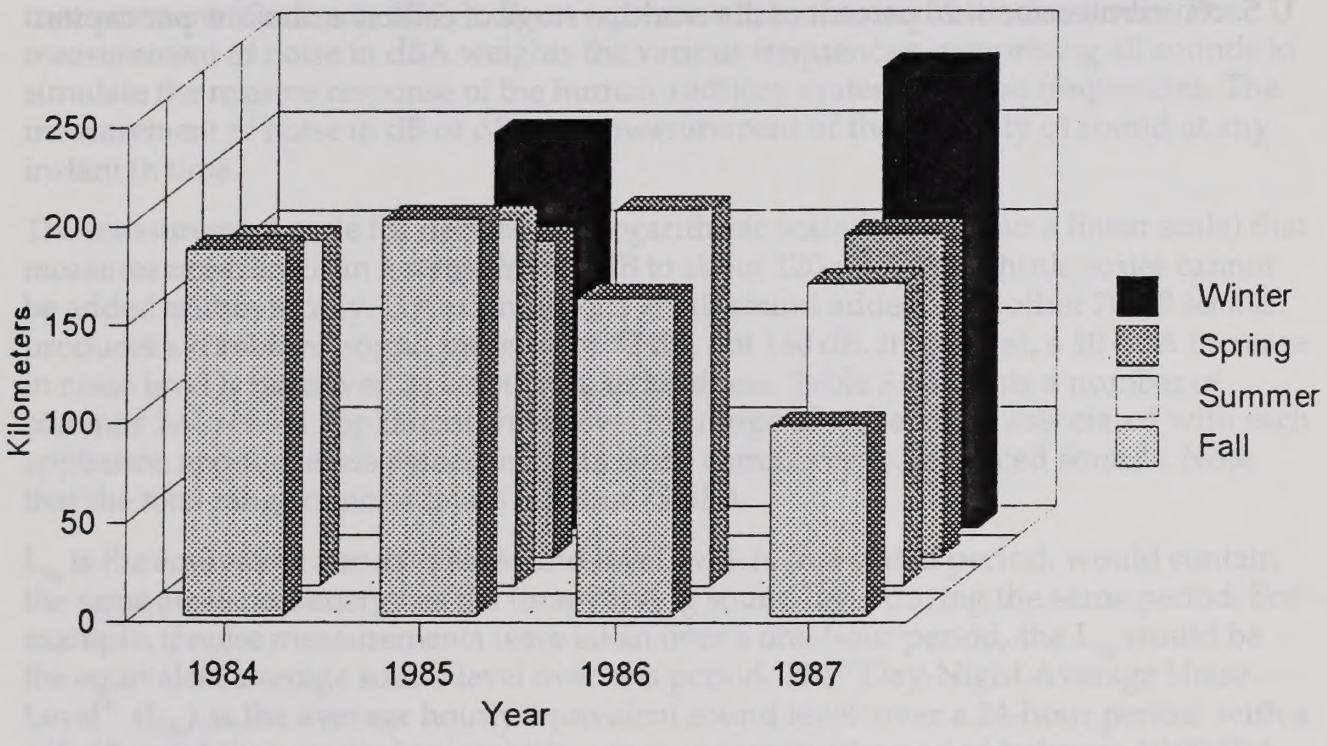
Visibility

Photographic monitoring of visibility was performed in the Lava Beds National Monument by the National Park Service during the period of 1985 to 1988. Both Class 1 areas are within the Lava Beds National Monument, hence these measurements are representative of those highly sensitive areas. Day-to-day variations in visual air quality were determined from 35 mm slides, and expressed as standard visual range. Those measurements are summarized as seasonal means in a bar-graph format in Figure 3.13-4. Generally, the mean visibility is 150 kilometers (km) or greater. The only seasonal mean less than 150 km was in the fall of 1987. The maximum mean visual range was greater than 225 km, which occurred during the 1987 winter. It should be noted that photographs and data derived from them only estimate the visual range and there is considerable uncertainty associated with this type of determination.

Global Warming

Throughout the world, energy is obtained and goods and services produced primarily through the burning of fossil fuels. These combustion processes, while providing a practical energy source, emit CO_2 and increase the amount present in the earth's atmosphere. Many experts within the scientific community believe that the increase in CO_2 is leading to a global temperature increase, or global warming, because CO_2 and other greenhouse gases trap heat in the earth's atmosphere. There is presently some

Figure 3.13-4: Visibility in the Project Area



controversy over the scale and timing of these effects, but many people believe that global warming could have adverse effects on life on earth.

Over the past century, the mean global temperature has been estimated to have increased 0.5 degrees Celsius (USFS et al. 1994). While there is some debate in the scientific community as to whether this temperature increase can be attributed to the greenhouse effect vs. natural causes (e.g., variability in solar activity), the greenhouse effect and its potential effect on global climate are of concern. The extent to which climatic changes caused by global warming may prove significant in the future depends on the rate of release of CO_2 and other greenhouse gases into the atmosphere.

Studies of the greenhouse effects traditionally express CO_2 as pounds of carbon. The U.S. contributes about 20 percent of the world average of carbon emissions per capita.

3.14 Noise

INTRODUCTION

Small variations in air pressure, which are sufficient to affect or stimulate the drum (or tympanic membrane) of the human ear, are heard and interpreted as either "sounds" or "noise". Noise is measured as the change in this sound pressure level exerted on the microphone (a thin metallic diaphragm) of a sound level meter. This section is provided to explain terms used to describe existing conditions and the expected impacts of the proposed project with regard to noise.

Noise is usually measured in terms of decibels (dB) or decibels A-weighted (dBA). The measurement of noise in dB is a direct representation of measured noise levels. The measurement of noise in dBA weights the various frequencies comprising all sounds to simulate the relative response of the human auditory system to those frequencies. The measurement of noise in dB or dBA is a measurement of the intensity of sound at any instant in time.

The measurement scale for decibels is a logarithmic scale (rather than a linear scale) that measures noise levels in a range from 0 dB to about 120 dB. Logarithmic scales cannot be added arithmetically. For example, one 70 dB sound added to another 70 dB sound produces a combined sound pressure of 73 dB, not 140 dB. In general, a 10 dBA increase in noise level is perceived as a doubling in loudness. Table 3.14-1 lists a number of common household appliances and shows the range of noise levels associated with each appliance, and the levels associated with some commonly experienced sounds. Note that the total range of noise levels is about 75 dBA.

L_{eq} is the equivalent steady-state sound level, which, in a stated period, would contain the same acoustical energy as the time-varying sound level during the same period. For example, if noise measurements were taken over a one-hour period, the L_{eq} would be the equivalent average sound level over this period. The "Day-Night Average Noise Level" (L_{dn}) is the average hourly equivalent sound level over a 24-hour period with a +10 dB weighting applied to nighttime measurements (the period between 10:00 PM and 7:00 AM). The statistical noise level method (L_{10}, L_{50}, etc.) describes how often a given sound level is exceeded during the period of measurement. For example, L_{10} is the noise level that would be exceeded 10 percent of the time and would generally represent louder noise levels that occur infrequently in the environment. Conversely, the L_{90} noise level would be exceeded most of the time (90 percent of the time), and would generally represent the background noise level or low ambient noise levels in the environment.

In general, noise that may disrupt human activities or which may degrade the quality of a human's environment is considered to be a nuisance by humans. The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, in the range of usual environmental noise levels, perception of loudness is relatively predictable. There is a strong correlation between dBA and community response to noise. In terms of community response, it is generally valid that a change in noise level of at least 5 dBA is required before any noticeable

Table 3.14-1: Typical Noise Sources and Levels

Noise Source	Noise Level (dBA)
Rustle of Leaves in Breeze	25
Whisper (at 6 feet)	35
Inside Average Residence	40
Refrigerator (in same room)	40
Average Office	55
Normal Female Speech (at 3 feet)	60
Vacuum Cleaner (at 10 feet)	70
Garbage Disposal (at 3 feet)	80
Food Blender (at 3 feet)	90
Auto Horn (at 10 feet)	100

SOURCE: CIEA 1997

change in community response would be expected (Harris 1991). Human hearing systems are most sensitive to sounds in the range of 1,000 to 4,000 Hertz (Hz) and less sensitive to lower and higher frequencies (Gales 1979).

STUDY AREA

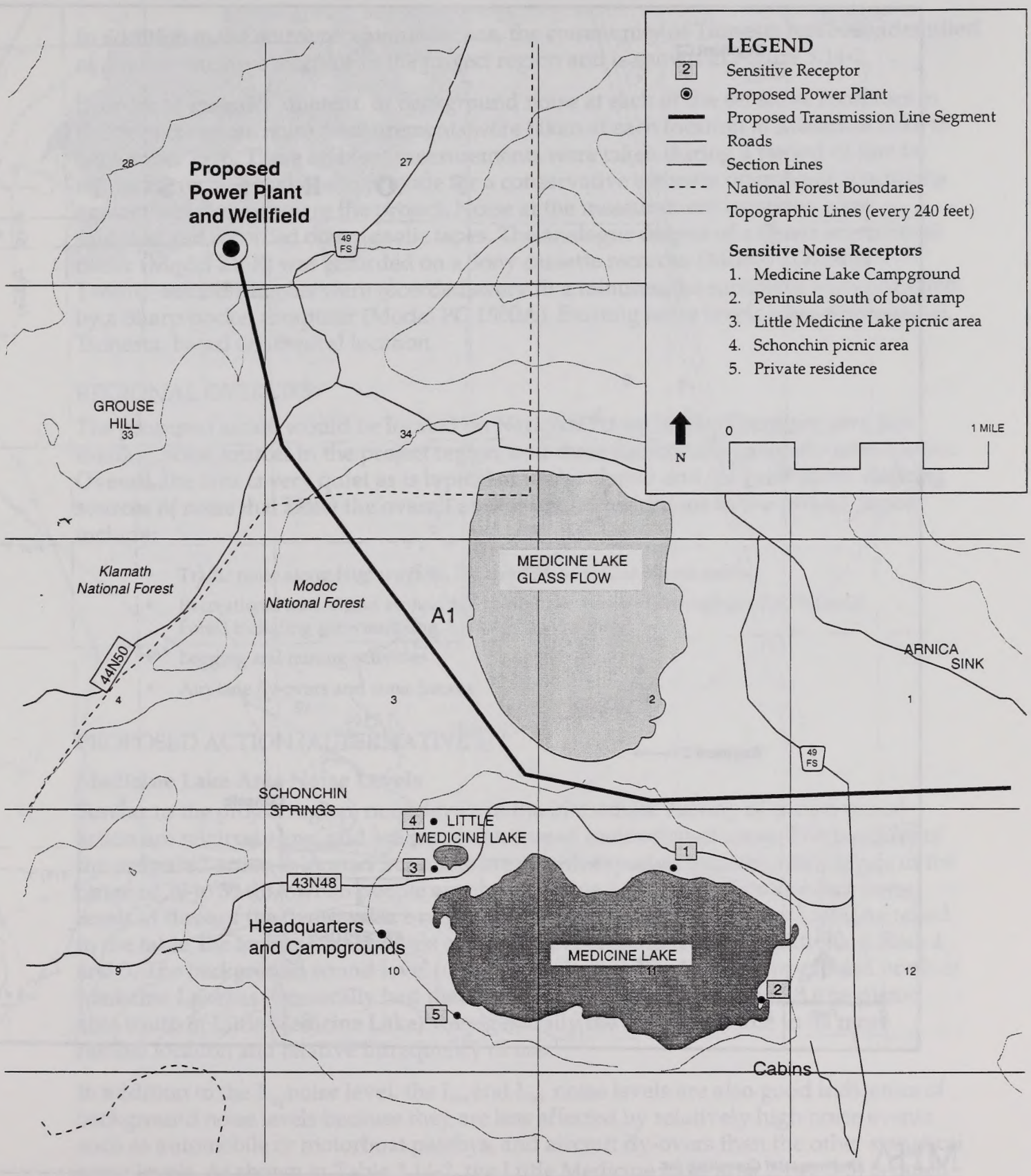
The study area for the noise analysis consists of the general vicinity of the proposed wellfield and power plant area, as well as the proposed and alternate transmission line corridors. The study area includes sensitive receptors that could be exposed to noise generated by construction, operation, or decommissioning activities at the wellfield and power plant area and along the transmission line route. Sensitive receptors in the study area include recreational areas and seasonal residences at Medicine Lake, the community of Tionesta, and sites important to local tribal members (see Figure 3.14-1 and Figure 3.14-2).

METHODOLOGY

Seasonal residents and visitors most likely to be affected by project noise are located in the Medicine Lake area; therefore, five sensitive receptor sites were identified around the lake where people congregate. These sites are the residences, campgrounds, and recreational facilities closest to the wellfield and power plant area. The five sites are identified below and shown in Figure 3.14-1.

- Site 1 was in the campground north of Medicine Lake at Campsite No. 31, which is about 50 feet from the road
- Site 2 was on the small peninsula south of the boat ramp on the southeastern side of Medicine Lake
- Site 3 was near the homes and picnic area south of Little Medicine Lake

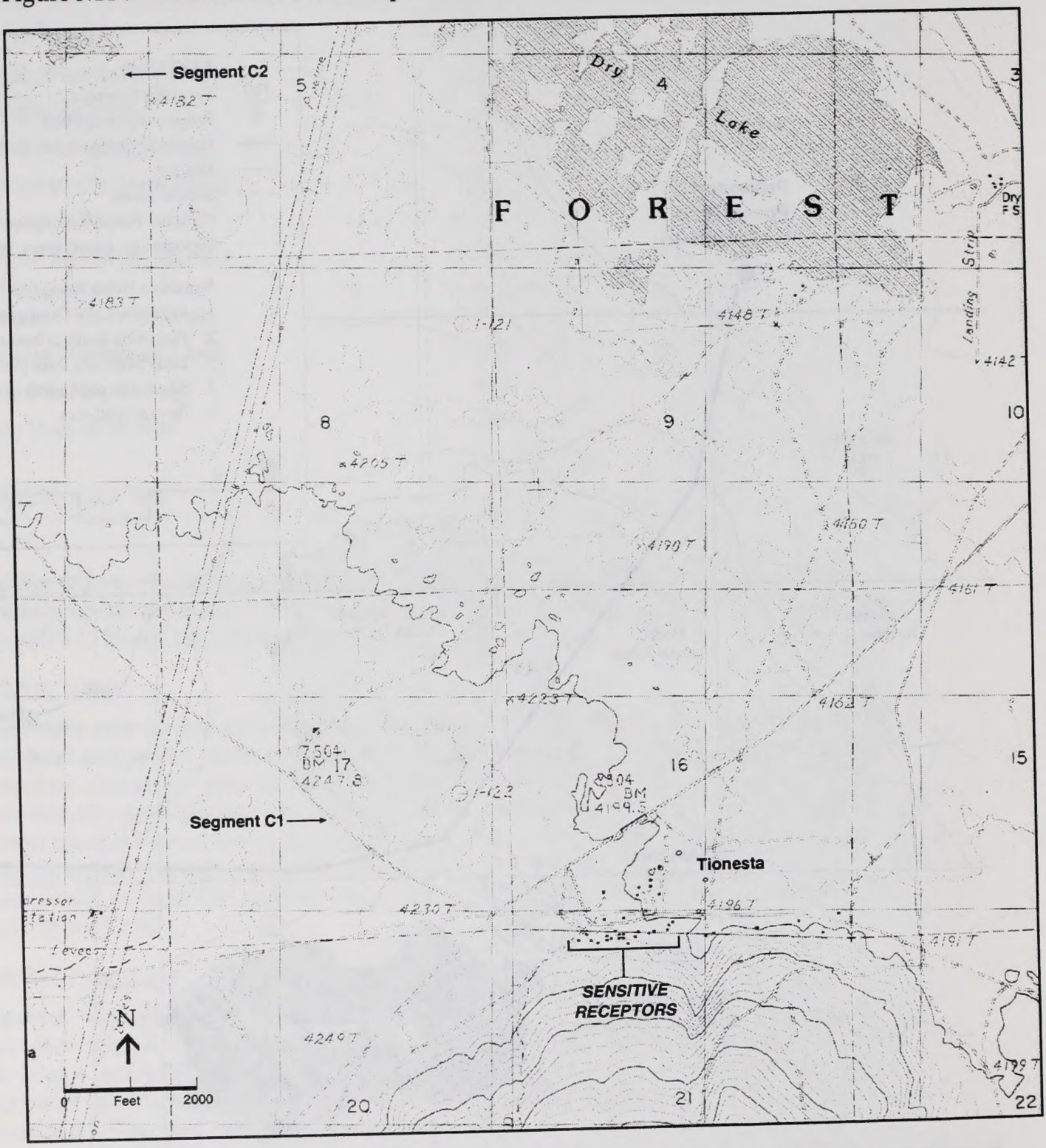
Figure 3.14-1: Medicine Lake Sensitive Noise Receptors



MHA *Environmental Consulting, Inc.*

SOURCE: Consultants in Engineering Acoutics

Figure 3.14-2: Tionesta Sensitive Receptor Locations



- Site 4 is the Schonchin picnic area just north of Little Medicine Lake
- Site 5 is the home on the southwest corner of Medicine Lake

In addition to the above receptor locations, the community of Tionesta has been identified as a noise-sensitive receptor in the project region and is shown in Figure 3.14-2.

In order to measure ambient, or background noise at each of the sensitive receptors in the project region, noise measurements were taken at each location at Medicine Lake in September 1996. These ambient measurements were taken during a period of low to moderate recreational use to provide for a conservative estimate of ambient conditions against which to compare the project. Noise at the measurement locations were sampled and recorded on magnetic tapes. The analogue output of a Quest sound level meter (Model 215R) was recorded on a Sony cassette recorder (Model TDC5M). Twenty-second samples were recorded every five minutes; the sampling was controlled by a Sharp pocket computer (Model PC 1500A). Existing noise levels were estimated at Tionesta, based on its rural location.

REGIONAL OVERVIEW

The proposed action would be located on National Forest lands. There are very few existing noise sources in the project region, and these sources are generally intermittent. Overall, the area is very quiet as is typical of undeveloped and/or rural areas. Existing sources of noise that affect the overall ambient noise conditions in the project region include:

- Traffic noise along Highways 49, 79, and 139, as well as Forest roads
- Recreational uses in and around Medicine Lake area and throughout the National Forest including snowmobiling, hunting, and boating
- Logging and mining activities
- Airplane fly-overs and sonic booms

PROPOSED ACTION (ALTERNATIVE 1)

Medicine Lake Area Noise Levels

Similar to the project region, noise levels in the immediate vicinity of the proposed action are relatively low, and are representative of undeveloped areas. The majority of the proposed action is located in remote areas with expected ambient noise levels in the range of 20 to 30 dBA when people are absent. Table 3.14-2 identifies ambient noise levels at three of the five sensitive noise receptor sites around Medicine Lake. As noted in the table, the ambient noise levels at Site 3 are representative of conditions at Sites 4 and 5. The background sound level (or L_{eq}) is highest at Site 1 (the campground north of Medicine Lake) as it generally had the most people. Noise levels at Site 3 (the picnic area south of Little Medicine Lake) were generally the most quiet due to its more remote location and relative infrequency of use.

In addition to the L_{eq} noise level, the L_{90} and L_{99} noise levels are also good indicators of background noise levels because they are less affected by relatively high noise events such as automobile or motorboat passbys, and aircraft fly-overs than the other statistical noise levels. As shown in Table 3.14-2, the Little Medicine Lake area (Sites 3-5) is much

Table 3.14-2: Ambient Noise Levels at Medicine Lake[1]

Site	Noise Levels in dBA							[5]Noise Levels Representative of Conditions Elsewhere[3]
	L_{dn}[2]	L_{eq}[3]	L_{01}[4]	L_{10}[4]	L_{50}[4]	L_{90}[4]	L_{99}[4]	
1. North Campground ≈50 ft from road (Campsite 31)	43.4	37.0	41.9	38.9	36.8	30.3	28.1	Campgrounds on north side of Medicine Lake
2. Southeast corner of Medicine Lake, south of boat ramp	42.2	35.8	44.7	38.8	33.4	30.7	29.7	Group of homes southeast of Medicine Lake
3. Homes and Picnic area near Little Medicine Lake	39.4	33.0	42.9	37.0	28.2	24.7	23.9	Schonchin Picnic Area (Site 4), north of Little Medicine Lake; home on southwest end of Medicine Lake (Site 5)

Notes:

1 The values shown are averages over recording periods conducted in September 1996.

2 L_{dn} is the average hourly equivalent sound level over a 24-hour period with a +10 dB weighting applied to the nighttime.

3 L_{eq}, or equivalent sound level, is the loudness of a constant sound having the same sound energy as the actual sound which varies in loudness over a given time period.

4 L_{01}, L_{10}, etc. is the noise level exceeded 1, 10 etc. percent of the time over a specified time period. L_{01} can be considered the maximum, or loudest noise level, while L_{99} is the lowest, or most quiet.

5 The ambient noise measurements taken at receptor locations 1 through 3 are also representative of ambient noise levels at the other locations identified in this column. The Schonchin Picnic Area (Site 4) and the home on the southwest corner of Medicine Lake (Site 5) would have similar ambient noise levels to those measured at Little Medicine Lake (Site 3).

6 Ambient noise measurements were obtained on September 13 and 14, 1996.

SOURCE: Consultants In Engineering Acoustics 1996

quieter (by about 6 dBA) than the other two sites.

During noise measurements at Medicine Lake, the campsite occupancy rate was about 10 to 15 percent. When the campgrounds are fully occupied (e.g., during peak summer usage), higher noise levels would be expected to occur. In general, the noise levels would be expected to be about 8 dBA higher during peak use periods, than shown in Table 3.14-2. At night, however, when human activities slow down, background levels are expected to be roughly similar to those shown in Table 3.14-2.

In addition to higher noise levels during periods of high campsite occupancy rates, other factors may intermittently increase noise levels above those shown in Table 3.14-2. Snowmobile use during winter and rifle noise during the hunting season could result in intermittent noise in the project area and at Medicine Lake.

Table 3.14-3 identifies ambient octave band sound levels at Medicine Lake. Octave band sound levels are not A-weighted; rather, the relative response of the sound level meter to the noise frequencies is flat, or similar for all of the frequencies. An octave band of frequencies is one in which the highest frequency has twice the value of the lowest. For example, the lowest frequency is 177 Hz in the 250 Hz octave band, while the highest is about 355 Hz. For reference, the predominant frequency of middle C on the piano is about 250 Hz but the piano produces a tone at 250 Hz, not an octave band of sounds.

Table 3.14-3: Ambient Octave Band Sound Levels[1] at Three Representative Receptor Locations

	Octave Band Center Frequency (in dB)								
Location of Receptor	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1 Khz**	**2 Khz**	**4 Khz**	**8 Khz**	**Overall in dBA L_{eq}**
1. Campgrounds on north side of Medicine Lake	53.8	48.7	31.6	35.7	23.5	23.7	18.4	12.7	37.1
2. Group of homes southeast of Medicine Lake	52.7	42.1	34.7	33.0	28.5	25.0	20.1	18.5	35.5
3-5. Little Medicine Lake area sites	48.5	35.6	35.0	28.0	24.3	22.1	22.1	23.6	32.7

Notes:

[1] The octave band sound levels shown are an average calculated from ten brief samples at each of the three locations; the average level has been adjusted to result in an overall A-weighted L_{eq} (right-hand column) approximating the L_{eq} shown in Table 3.14-1.

SOURCE: Consultants In Engineering Acoustics 1996

Tionesta Noise Levels

Ambient noise measurements were not conducted near Tionesta, as noise levels in the vicinity of Tionesta are expected to be low and typical of rural and open space areas. These noise levels are expected to range from 25 to 45 dBA, depending on the time of day. This expectation is supported by the ambient noise measurements taken around Medicine Lake, which ranged from 24 dBA to 45 dBA, depending on the time of day.

ALTERNATIVES

Existing ambient noise levels in the vicinity of each alternative and at sensitive receptors near each alternative are the same as described for the proposed action.

3.15 Human Health and Safety

DEFINITION OF STUDY AREA

Human health and safety issues can be of concern to residents and communities throughout the project region, as well as to visitors to the area. Potential effects on human populations from the proposed project have been analyzed in this section. The study area for the analysis of human health and safety issues covers a wide geographic area. The study area includes the Klamath and Modoc National Forests, as well as communities along transportation routes that could be used for the proposed project. On a more local scale, the proposed project study area would include the area encompassing the proposed wellfield and power plant site, and the proposed and alternative transmission line routes. However, since existing conditions that could pose a risk to human health and safety occur on a more regional basis, the majority of these conditions are discussed under the proposed project. Any differences in existing human health and safety risks for the alternatives are identified in each alternative discussion.

METHODOLOGY

This section addresses three areas of concern related to human health and safety issues for the proposed project:

- Hazardous materials
- Fire hazards
- Electric and magnetic fields (EMF)

For information on hazardous materials, the Klamath and Modoc National Forests LRMPs were reviewed. In addition, information on materials that would be used during project construction, operation, and decommissioning was obtained from Calpine. This information was reviewed and compared to hazardous classifications identified in Title 22 of the California Code of Regulations (CCR).

For fire hazards, the USFS provided information on the past fire history of the Klamath and Modoc National Forests, and the Klamath and Modoc Forest LRMPs were reviewed (USFS 1995 and USFS 1991). Information on fire protection services on the National Forests also was obtained from the USFS (also see Section 3.16, Socioeconomics). The potential for the proposed project to increase fire hazards or expose people to fire hazards was assessed in the context of the existing frequency of fire hazards and the USFS ability to fight fires.

Literature which summarizes studies done on EMF exposure and effects to humans was reviewed for this section and is listed as follows:

- Bonneville Power Administration. 1993. *Electric Power Lines-Questions and Answers on Research into Health Effects*. November 1993.
- Bonneville Power Administration. 1993. *What We Know (and don't know) About EMF*. January 1993.
- National Institute of Environmental Health Services and U.S. Department of Energy. 1995. *Questions and Answers About EMF Electric and Magnetic Fields Associated with the Use of Electric Power*. January 1995.

Human health and safety issues related to air quality are addressed in Section 4.13, Air Quality.

PROPOSED ACTION (ALTERNATIVE 1)

Hazardous Materials

Significant volumes of hazardous materials are commonly associated with intensive land uses such as industrial or mining uses. The proposed project is located within a portion of the Klamath and Modoc National Forests where minimal, if any, industrial uses may have occurred. The proposed project site is not known to have been used for such purpose. In addition, no known hazardous material sites exist within the proposed project area.

Mining activities near the project area are located at several rock quarries (BLM et al. 1995). The rock quarries contain basaltic cinder used by the USFS. Isolated pumice quarries are known to be inactive; however, a quarry located on the north flank of Glass Mountain (see Figure 3.2-2 in Section 3.2 of Geology and Soils) has been operational since 1934. The only known hazardous materials used for these mining activities are oil, fuel, and lubricants.

Limited information is available regarding the existing volume of hazardous materials transport along roadways in the project region. Due to the limited number of hazardous material generators in the immediate project vicinity and the fact that the landfills in Klamath and Modoc Counties do not accept hazardous waste (see Section 3.16, Socioeconomics), it can be inferred that minimal hazardous material transport occurs on roadways within the area. However, the most common and potentially hazardous material transport is of gasoline and diesel fuel, as it is being transported by truck to various gas stations located throughout the region. Interstate 5, which is located approximately 40 miles to the west of the project area, is a route commonly used by transporters.

Fire Hazards

Fires are a naturally occurring phenomena in forested areas, and serve to shape and reshape the vegetative patterns and structures of these areas. Fire is a dominant force in facilitating natural regeneration, arresting succession, controlling forest stand density, and removing dead and downed woody material (USFS 1995). Wildfires frequently occur during periods of drought, as more dead woody material builds up and serves as fuel. The fire season is generally considered to last from late May through mid-October, when there are periods of high temperatures and little to no moisture in the air. Fire history, current management practices, and fire detection and suppression on the Klamath and Modoc National Forests are discussed below.

Fire History: On the Klamath and Modoc National Forests, most recorded wildfires in recent history have been started by lightning strikes, which is an uncontrollable and unpredictable source of ignition. During the periods for which fire records are currently available (1950 through 1990 on the Klamath, and 1910 to 1980 on the Modoc), about 75% of the fires on both Forests have been started by lightning. The remaining 25% of fires have been started by people. Escaped campfire debris, discarded cigarettes, and

out-of-control slash burning fires are common causes and continue to be a persistent problem on the Forests (USFS 1995 and USFS 1991).

The number of wildfires per year and the acreage of burn per wildfire can vary widely based on climatic conditions, the availability of fuels, and the ability of fire-fighters to contain a given wildfire. On the Klamath National Forest, the annual number of wildfires has ranged from about 90 to up to 340 fires per year, with an average of about 170 forest fires per year. The acreage burned per year by these fires has ranged from less than an acre to over 275,000 acres, with an average of about 12,000 acres burned by wildfires per year. The number of wildfires per year and the acreage of burn per wildfire on the Modoc National Forest has been generally consistent with the occurrences on the Klamath (USFS 1995 and USFS 1991).

As part of its analysis for the Goosenest Adaptive Management Area (AMA) Ecosystem Analysis, the Goosenest District on the Klamath National Forest has identified the fire behavior potential for areas within the District (USFS 1996). The fire potential categories include non-flammable, low, moderate, and high. The fire potential for areas within the Goosenest District is based primarily on vegetation mortality that has been identified through overflights of the District. In general, the higher the mortality, the greater the potential for fire to occur. Due to time constraints during preparation of the AMA Ecosystem Analysis, most areas with moderate and high mortality were categorized by the Goosenest District as having a high fire behavior potential (USFS 1996).

The Doublehead District on the Modoc National Forest is in the process of finalizing a similar report called the Medicine Lake Highlands Managed Late Successional Area Assessment (USFS 1997). This report identifies similar fire potential categories and fire potential areas based on vegetation type, age, and mortality.

The proposed wellfield, power plant area, and a portion of transmission line segment A1 would be located within the Goosenest District. The location of the wellfield and power plant has been categorized as having a high fire behavior potential by the Goosenest District. Segment A1 would pass through a mosaic of areas with low, moderate, and high fire behavior potential (USFS 1996).

Current Management Practices: On both the Klamath and Modoc National Forests, several methods are used to prevent and suppress forest fires. Fire prevention activities include public outreach and education efforts, forest patrols, and controlled underburnings. In recent years, forest management practices have been modified with the acknowledgment that occasional forest fires are necessary for a properly functioning forest ecosystem. Controlled burns serve to clear out the build-up of downed woody materials; this underburning can help prevent larger and more serious conflagrations from occurring. Selective thinning and other silvicultural techniques also are used to develop healthier forest stands, which are generally more fire resilient (USFS 1995 and USFS 1991).

Fire Detection and Suppression: Strategic vantage lookout points within the Forests allow for early identification of wildfires. After lighting storms in the area, USFS personnel conduct reconnaissance flights over the Forests to assist in wildfire identification. The USFS also maintains a cooperative agreement with the California Department of Forestry (CDF). This agreement allows the CDF to assist the USFS in fire

suppression efforts on the Forests, and the USFS to assist the CDF in fire suppression efforts in surrounding forested areas. The USFS has similar agreements with the BLM and Lava Beds National Monument for fighting fires in the region.

Depending on the severity and nature of a wildfire, a combination of fire breaks, water, and fire retardants are usually used to suppress wildfires. Both Forests maintain a full complement of wildfire suppression equipment, including fire engines, helicopters, and retardant aircraft. Each Forest also has staff that can serve as hand crews for creating fire breaks and conducting on-the-ground wildfire suppression activities (USFS 1995 and USFS 1991).

Electric and Magnetic Fields

A wide variety of sources produce EMFs, both in nature and from man-made sources. Electric transmission lines, electrical wiring, and household appliances all produce EMFs. EMFs consist of two types of fields: electric and magnetic. The following discussion describes both electrical fields and magnetic fields, and provides information on major existing sources of EMF in the project vicinity.

Electric Fields: Electric fields are a very common phenomenon, and can be generated by sources ranging from the human body (static electricity) to household appliances to major electrical facilities. Electric fields are caused by the potential or voltage (electrical pressure) on an object. Any object with an electric charge has a voltage at its surface, and all household appliances and other devices that operate on electricity create electric fields. The voltage effect is not limited to the surface of an object, but exists in the space surrounding the object. The electrical field is strongest near a charged object and decreases with the distance from the object (National Institute of Environmental Health Services and U.S. Department of Energy 1995).

Typically, electric fields related to EMFs are generated by alternating current (AC) sources. AC is the predominant electrical system in the world. AC differs from the electrical fields produced naturally by the earth and the human body; otherwise known as direct current (DC) fields.

One of the most common sources of AC electrical fields is household appliances, which typically produce fields that reverse direction at a rate of 120 times per second, or 60 Hertz (Hz, or cycles per second). Household appliances need not be in operation to create an electrical field; plugging an appliance into an electrical outlet creates an electric field around the appliance. The electrical fields from point sources, such as household appliances, generally attenuate more rapidly with distance than line sources, such as power lines (National Institute of Environmental Health Services and U.S. Department of Energy 1995).

Similar to household appliances, transmission lines typically generate 60 Hz electric fields. The electric fields from transmission lines are relatively stable because line voltage remains constant. The electric fields close to transmission lines are usually stronger than the fields found near electrical appliances. However, the strength of electric fields decreases significantly away from these source, and electrical field strength is greatly reduced by trees, the ground, and buildings (National Institute of Environmental Health Services and U.S. Department of Energy 1995). Table 3.15-1

Table 3.15-1: Typical Electric Field Strength at Varying Distances from Sources

	Electric Field (V/m)[1]				
	At Source	**1 foot**	**50 feet**	**100 feet**	**200 feet**
Household Appliances[2]					
Electric Oven	-	4	-	-	-
Vacuum Cleaner	-	16	-	-	-
Coffee Pot	-	30	-	-	-
Color Television	-	30	-	-	-
Refrigerator	-	60	-	-	-
Stereo/Tuner	-	90	-	-	-
Electric Blanket	-	250	-	-	-
230-kV Transmission Line[3]	2,000	-	1,500	300	50

Notes:

1 V/m = volts per meter.

2 Limited information is available for household appliance electrical field strength beyond 1 foot; due to the low levels and rapid decrease with distance, the electrical field strength much beyond 1 foot for most household appliances is expected to negligible.

3 Electrical field strength for transmission lines is measured approximately one meter above the ground at the varying distances indicated in this table.

SOURCE: BPA 1993

identifies typical electric field strength at varying distances from both household appliances and a typical 230-kV transmission line.

Electric substations also create electric fields. The equipment and components of a substation act as point sources for an electrical field, similar to an appliance at home. As the distance from these point sources becomes greater, the field is also greatly reduced. Electric field strength beyond the fenced boundaries of a substation is typically very low because of shielding from the equipment itself, as well as by the metal fencing surrounding the substation (CPUC and BLM 1995).

Electrical fields can sometimes result in corona, a physical manifestation of energy loss. Corona is the luminous discharge associated with ionization of air next to a source of high voltage, such as transmission lines. Corona can transform energy into small amounts of light, sound, chemical reaction, and heat. For example, corona often causes radio and television reception interference by generating a high-frequency noise called electro-magnetic interference (EMI). EMI can be heard when driving under transmission lines of 345 kV or greater. This effect is local and is not a serious problem or hazard (CPUC and BLM 1995).

Magnetic Fields: Like electric fields, magnetic fields are a very common phenomenon that are generated by both natural and man-made sources. Magnetic fields are caused from an electric current flowing in a conductor (electrical equipment, household appliance, power circuits, etc.). Since the magnetic field is caused by the flow of an electrical current, a device must be operated to create a magnetic field. Magnetic field strength is affected by the distance from the source of the field, and the configuration of the source itself. Unlike electrical fields, which are easily shielded from common objects, magnetic fields are more difficult to shield (CPUC and BLM 1995).

Similar to electric fields, the magnetic field of a household appliance decreases rapidly with distance away from the device. The magnetic field also decreases away from line sources, such as transmission lines. Household appliances and transmission lines commonly are 60 Hz AC; therefore, generate AC magnetic fields. Table 3.15-2 identifies typical magnetic field strength at varying distances from both household appliances and a standard 230-kV transmission line.

Transmission line magnetic fields are generated by the flow of current along the phase conductors. Unlike electrical fields, magnetic fields are not constant over time because the current on any transmission line changes in response to increasing and decreasing loads. Magnetic fields associated with a substation decrease with distance and are not shielded by most common objects, as mentioned above. (CPUC and BLM 1995).

Table 3.15-2: Typical Magnetic Field Strength at Varying Distances from Sources

	Magnetic Field (mG)				
	At Source	**1 foot**	**50 feet**	**100 feet**	**200 feet**
Household Appliances					
Coffee Pot	-	1	-	-	-
Stereo/Tuner	-	1	-	-	-
Refrigerator	-	2	-	-	-
Color Television	-	11	-	-	-
Electric Oven	-	14	-	-	-
Electric Blanket	22	-	-	-	-
Vacuum Cleaner	-	70	-	-	-
230-kV Transmission Line	58	-	20	7	2

Notes:

[1] mG = milligauss.

[2] Limited information is available for household appliance magnetic field strength beyond 1 foot; due to the low levels and rapid decrease with distance, the magnetic field strength much beyond 1 foot for most household appliances is expected to negligible.

[3] Magnetic field strength for transmission lines is measured approximately one meter above the ground at the varying distances indicated in this table.

SOURCE: BPA 1993

Major Existing Sources of EMF in the Project Vicinity: Major existing EMF sources in the project vicinity primarily include the five existing transmission lines and associated substations located in western Modoc County near Tionesta. Three transmission lines are each located in separate transmission line corridors, and two lines are located within the same corridor. These existing transmission lines are identified in Figure 2.2-2, and the locations and characteristics of these lines are discussed below.

- The BPA Malin-Warner 230-kV transmission line is located approximately 3 miles west of Tionesta, generally parallels Highway 139, and passes through the project vicinity in a northwest-to-southeast direction
- The PacifiCorp "Line 5" 69-kV transmission line, which, like the BPA Malin-Warner line, is located approximately 3 miles west of Tionesta, generally parallels Highway 139, and passes through the project vicinity in a northwest-to-southeast direction
- The California Oregon Transmission Project (COTP) 500-kV transmission line is located approximately 5 miles east of Tionesta and generally passes through the project vicinity in a northeast-to-southwest direction
- The PacifiCorp and US WAPA 500-kV transmission lines are located within the same transmission line corridor approximately 3 miles due east of the COTP line; similar to the COTP line, these lines generally pass through the project vicinity in a northeast-to-southwest direction

EMF levels associated with these transmission lines are expected to be varied. The BPA Malin-Warner 230-kV line is expected to generate EMFs similar to those identified for 230-kV transmission lines in Tables 3.15-1 and 3.15-2. The PacifiCorp "Line 5" 69-kV line is expected to generate electric fields and magnetic fields at about one-third of the strength identified in Tables 3.15-1 and 3.15-2 for 230-kV transmission lines. The COTP, PacifiCorp, and US WAPA 500-kV transmission lines are expected to generate electric field strengths about five times higher than those identified for 230-kV transmission lines in Tables 3.15-1 and 3.15-2, and magnetic fields strengths about 1.5 times higher than those identified for 230-kV transmission lines in Tables 3.15-1 and 3.15-2.

EMFs are also present at varying levels near all types of electrical facilities and appliances in the project vicinity, including those in the homes at Tionesta and at Medicine Lake. Electricity is supplied to homes at Medicine Lake via generators. The levels of EMF generated by most home appliances and facilities is negligible, as illustrated in Tables 3.15-1 and 3.15-2.

ALTERNATIVES

As discussed at the beginning of this chapter, the following describes the affected environment for each alternative to the proposed project. Alternatives to the proposed project include various alternate transmission line routes (Alternatives 2 through 6) and the No Action alternative (Alternative 7).

For Alternatives 2 through 6, the affected environment for the proposed wellfield and power plant would be the same as described for the proposed project since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route; therefore, descriptions of the existing environment along these portions of the transmission line are not repeated

under each alternative discussion. The description of the affected environment for these alternatives focuses on those segments of the transmission line that would be different from those in the proposed project, and provides references for those segments that have been previously discussed under the proposed project or a preceding alternative discussion.

Alternative 2 (Segments A1, A2, B1, C2)
Existing human health and safety issues are generally the same for this alternative as described for the proposed project. However, segment C2 is located a greater distance from residents in Tionesta than segment C1.

Alternative 3 (Segments A1, B2, C1)
Existing human health and safety issues are generally the same for this alternative as described for the proposed project.

Alternative 4 (Segments A1, B2, C2)
Existing human health and safety issues are generally the same for this alternative as described for the proposed project. However, segment C2 is located a greater distance from residents in Tionesta than segment C1.

Alternative 5 (Segments A3, B1, C1)
Existing human health and safety issues are generally the same for this alternative as described for the proposed action. However, this alternative uses transmission line segment A3 instead of segments A1 and A2, so the fire behavior potential identified in the Goosenest District AMA Ecosystem Analysis for this alternative is different. The western portion of segment A3 is in an area that has been categorized as having a high fire behavior potential (USFS 1996). In addition, this alternative would route the transmission line away from residences and campgrounds at Medicine Lake.

Alternative 6 (Segments A3, B1, C2)
Existing human health and safety issues are generally the same for this alternative as described for the proposed action. Similar to Alternative 5, this alternative uses transmission line segment A3 instead of segments A1 and A2. The western portion of segment A3 is in an area that has been categorized as having a high fire behavior potential (USFS 1996). In addition, this alternative would route the transmission line away from residences and campgrounds at Medicine Lake. Also, segment C2 is located a greater distance from residents in Tionesta than segment C1.

Alternative 7 (No Project)
The existing human health and safety issues of Alternative 7, the No Action alternative, are the as for the proposed action and alternatives.

3.16 Socioeconomics

INTRODUCTION

This section describes the existing socioeconomic conditions in the vicinity of the proposed action. The following topics are discussed in this section:

- Population
- Employment
- Housing and lodging
- Schools
- Police, fire protection and emergency services
- Water and sanitary sewer services
- Solid waste disposal
- Utility systems
- Public finance

STUDY AREA

The proposed wellfield and power plant area is located on the Klamath National Forest in Siskiyou County. The proposed transmission line route is located on the Klamath and Modoc National Forests in Siskiyou and Modoc Counties. The potential socioeconomic effects of the proposed action could occur on a regional basis. The study area for socioeconomic conditions therefore includes both Siskiyou and Modoc Counties. In addition, because some employees of the project might choose to live in Klamath Falls, Oregon, the analysis evaluated housing and school capacities in Klamath Falls.

METHODOLOGY

Material reviewed as a part of this analysis included the Siskiyou and Modoc County General Plans, the Klamath and Modoc National Forest LRMPs, and 1990 census data from the California Department of Finance. Information was also gathered from representatives of the following agencies:

- Klamath National Forest
- Modoc National Forest
- Siskiyou County, including the Planning Department, Public Works Department, and Superintendent of Schools
- Modoc County, including the Department of Public Works, Office of the Auditor and Recorder, and Office of Education
- Klamath Falls City School District
- Klamath County School District

PROPOSED ACTION (ALTERNATIVE 1)

Population

Siskiyou County: According to the California Department of Finance, the population of Siskiyou County was 44,596 as of January 1, 1996. Approximately 20,376 people, or 46 percent of the population live in the incorporated cities of Dorris, Dunsmuir, Etna, Fort Jones, Montague, Mount Shasta, Tulelake, Weed, and Yreka (see Figure 2.2-1). The remaining 54 percent of Siskiyou County population, or 24,220 people, reside in unincorporated areas of the County (Department of Finance 1996).

Since 1980, the population of Siskiyou County has increased by an estimated 8.8 percent. By the year 2000, the population is expected to grow to 49,354, an estimated 12 percent over the 1990 population estimates (Department of Finance 1990; 1993). This increase is consistent with the historical trends for rural areas. The 1990 census reports the population density of Siskiyou County to be 7.1 people per square mile. This population density is considered sparse when compared to the state average of 156 people per square mile.

The 1990 Census reports indicate the age group with the highest representation in Siskiyou County (8.4 percent) was the 35-to-39 age bracket. This compares to statewide population where the 25-to-29 age group had the highest representation (9.6 percent). Siskiyou County has a higher percentage of people in the 50-and-older age group (31.7 percent) than the average statewide representation of approximately 22 percent (BLM et al. 1995a).

Modoc County: As of January 1, 1996, the population of Modoc County was 10,127 (California Department of Finance 1996). Modoc County population is generally distributed throughout the county, with the majority of the population residing in unincorporated areas. The City of Alturas is the only incorporated community within Modoc County. The City of Alturas contains 3,183 people, or 31 percent of the County total. The remaining 69 percent of the population, or 6,964 people, reside in unincorporated areas of Modoc County. Tionesta, the town located closest to the project area, has a population of approximately 30 people (Reed 1997, pers. com.).

During the past decade, Modoc County has experienced a moderate growth rate. Between 1980 and 1990, the County population grew from 8,610 to 9,678, representing an 11 percent increase (Modoc County 1988; Department of Finance 1990). By the year 2000, the population is expected to grow to approximately 11,500 people, a 16 percent increase over the 1990 estimates (Department of Finance 1993). The 1990 census reports the population density of Modoc County to be 2.4 people per square mile. As described above, this population density is considered sparse when compared to the state average (BLM et al. 1995a).

Modoc population characteristics illustrate that age is a key factor in county population statistics. There are an increasing number of older people in Modoc County. The median age has changed from 33.8 in 1980 to 37.2 in 1990. The trend shows a slight decreasing percentage of people under 18 (from 28.5 percent in 1980 to 27.5 percent in 1990) and an increasing percentage of people over 65 (from 13.9 percent in 1980 to 17.3 percent in 1990). This trend is most likely due to the in-migration of older age groups (primarily for retirement). The increase in median age of the population is a statewide trend; however, the median age of Modoc County residents is substantially older than the state median (Modoc County 1988).

Employment

The principal economic resources of Modoc and Siskiyou Counties are government employment, timber, agriculture, and recreation (see Table 3.16-1). The National Forests located within the two counties affect the agricultural sector by supplying livestock forage on public lands, which many ranches include as an integral part of their total operations. Recreation, particularly hunting, fishing, and camping on forest land, affects

the wholesale and retail trade and services sectors. Within the manufacturing sector, lumber and wood products (timber harvesting and mill work) comprise over 90% of total manufacturing employment. Timber also has a strong effect on the construction sector due to road construction and reconstruction requirements to transport harvested lumber (BLM et al. 1995b). Both the Klamath National Forest LRMP and Northwest Forest Plan identify diversification of the local economy as a goal (USFS 1994; USFS and BLM 1994).

Table 3.16-1: Total Employment by Sector

Sector	Siskiyou County (percent)	Modoc County (percent)	State (percent)
Government	23	36	15
Agriculture and Forestry	3	12	<2
Wholesale and Retail Trade	21	16	21
Services	25	23	30
Manufacturing	9	6	14
Construction	6	<5	5

SOURCE: BEA 1992; USFS 1991a

Siskiyou County: As shown in Table 3.16-1, the principal economic sectors for employment in Siskiyou County are services (25 percent), government (23 percent), and wholesale and retail trade (21 percent). Employment percentages in Siskiyou County are slightly higher than statewide averages for government, and slightly lower than state averages for services and manufacturing. Other sectors, including wholesale and retail trade, are roughly comparable to statewide averages.

Over the past twenty-five years, Siskiyou County has experienced a considerable shift in employment from manufacturing to more service jobs. Between 1970 and 1990, employment in manufacturing decreased from 22 percent to 9 percent, while employment in services increased from 14 percent to 25 percent (BEA 1992). Employment in trade and services is largely dependent on local demands resulting from changing population and consumer preferences and the demand generated by tourism and recreation.

As of 1990, the unemployment rate for Siskiyou County was 9.4 percent as compared to the statewide unemployment rate of 6.6 percent (California Department of Finance 1990).

Modoc County: As shown in Table 3.16-1, the principal economic sectors for employment in Modoc County are government (36 percent), services (23 percent), and wholesale and retail trade (16 percent). Compared to statewide averages, Modoc County has a much higher percentage of people employed by the government (36

percent in the county versus the state average of 15 percent) and in agriculture and forestry (12 percent for county versus less than 2 percent for the state average). Employment rates in the county are lower than state averages in the wholesale and retail trade, services, and manufacturing sectors.

Over the last 40 years, Modoc County employment has steadily moved from an agricultural and manufacturing (timber) employment base to a government and service based economy (Modoc County 1988). The population of Tionesta is primarily retirees. The store and RV park located in the town employ some residents. The pumice plant located on the northern flank of Glass Mountain also offers employment opportunities for the local population (Reed 1997, pers. com.)

As of 1990, the unemployment rate for Modoc County was 10.6 percent as compared to the statewide employment rate of 6.6 percent (California Department of Finance 1990).

Housing and Lodging

Siskiyou County: The total housing in Siskiyou County in 1996 was 21,519 housing units, which includes 3,882 mobile homes. The 1996 vacancy rate in Siskiyou County was about 14 percent or 3,045 units (California Department of Finance 1996). In the unincorporated sections of Siskiyou County and in the cities of Dorris, Tulelake, and Yreka, approximately two-thirds of the households are owner occupied and one-third are rented (California Department of Finance 1996). Temporary housing in Siskiyou County consists of approximately 20 RV parks, and over 78 inns and motels (BLM et al. 1995b).

There are approximately 35 residences in the vicinity of the proposed action on the southwest shore of Medicine Lake (Reed 1996, pers. com.). These residences are used as recreational or second homes and are not occupied year round. Property values of these residences range from about $30,000 to $125,000 and depend on the condition of the residence, type of property improvements, and the date of the last property appraisal (BLM et al. 1995b).

Modoc County: The total housing in Modoc County in 1996 was 5,088 housing units, which includes 1,266 mobile homes. The 1996 vacancy rate in Modoc County was about 21 percent or 1,066 units (California Department of Finance 1996). Modoc County's housing supply is divided into the unincorporated County of Modoc and the City of Alturas. Approximately 73 percent of the households in unincorporated Modoc County are owner occupied and 27 percent are renter occupied. Alturas households are 64 percent owner occupied and 36 percent renter occupied (California Department of Finance 1993).

Additional temporary housing in Modoc County consists of 10 recreational vehicle parks (RV parks) and 11 motels. Alturas has four trailer parks, one RV park and nine motels (Hironemus 1997, pers. com.). Motels are also located nearby in the towns of Cedarville and Canby.

Approximately 15 homes are located in Tionesta (Reed 1996, pers. com.). Property values of these homes range from about $50,000-60,000 (Hironemus 1997, pers. com.).

Klamath Falls, Oregon: The total number of housing units in the Klamath Falls area in 1990 was 7,832. The vacancy rate at that time was approximately 8 percent, or 625 units. Approximately one-half of the households in the city of Klamath Falls are owner occupied. Temporary housing in the city consists of approximately 9 RV parks and over twenty inns and motels. Several additional RV parks and motels are located in the area surrounding Klamath Falls (U.S. Census 1990).

Klamath and Modoc National Forests: Campgrounds within the Klamath and Modoc National Forests also provide sites for temporary lodging. However, the USFS limits the of campgrounds within National Forests. Users can stay up to 14 days per year at a given site, and they are limited to a total of 21 days per year for all sites within all National Forests. Due to severe winter conditions in the Modoc and Klamath National Forests, campgrounds in these forests are only open during the summer and early fall months. There are 30 campgrounds within the Klamath National Forest providing approximately 344 camp sites. The closest campground to the proposed project is located approximately 25 miles away and has ten camp sites. Within the Modoc National Forest, there are 24 campgrounds that provide approximately 300 camp sites. Four of these campgrounds, providing 73 camp sites, are located in the immediate vicinity of the proposed action (BLM et al. 1995b).

Schools

Siskiyou County: Table 3.16-2 identifies the schools and levels of current enrollment within the study area, as well as the estimated capacity of the two districts nearest to the project area. In Siskiyou County, Butte Valley Unified School District provides the school service nearest to the proposed action. The Butte Valley district currently has an enrollment of approximately 441 students and a total capacity of 465. However, the district plans to construct a new building, and it has not been determined yet what the capacity of the district will be once this building is completed.

Modoc County: In Modoc County, Tulelake Basin Joint Unified School District provides the closest school service to the eastern portion of the project area. The Tulelake Basin Joint Unified School District serves the Newell area with Tulelake Basin Elementary School and Tulelake High School in Tulelake. The Tulelake school district has a current enrollment of approximately 771 and an estimated capacity of 925.

Klamath Falls, Oregon: Klamath Falls residents are served by both the Klamath Falls City School District and Klamath County School District. The Klamath Falls City School District has a current enrollment of approximately 3,912; enrollment in the Klamath County School District is approximately 7,158. The schools in the Klamath Falls City School District are operating substantially below capacity; in the Klamath County School District, maximum capacity is estimated at 8,000 (KFCSD 1997, pers. com.; Smith 1997, pers. com.).

Police, Fire Protection, and Emergency Services

Police: The USFS provides police services within the Klamath and Modoc National Forests; these services are focused primarily on the protection of natural resources. Currently there are eight, full-time law enforcement officers stationed on the Klamath

Table 3.16-2: Educational Facilities in the Project Area

School District	Number of Schools	Enrollment (1996-7)	Capacity[1]
Siskiyou County:			
Elementary School Districts	24	5,264	
Secondary School Districts	13	2,607	
Butte Valley Unified School District	4	441	465[3]
Total	41	8,312	
Modoc County:			
Modoc Unified School District[2]	7	1,200	
Surprise Valley Unified School District	3	266	
Tulelake Basin Unified School District	4	771	925
Total	14	2,237	
Klamath Falls area:			
Klamath Falls City School District	9	3,912	
Klamath County School District	20	7,158	
Total	29	11,512	

Notes:

[1] Capacities are only shown for the two school districts which would be closest to the proposed project.

[2] Unified school districts include both elementary and secondary schools.

[3] Estimated capacity with the addition of a new planned school building has not been determined.

SOURCE: Modoc County 1997a; Siskiyou County 1997a; KFCSD 1997; Smith 1997

Forest, including one for each of the six ranger districts. There is one full-time and one part-time law enforcement officer on the Modoc National Forest. In addition to these officers, the USFS contracts with the Siskiyou County Sheriffs Department for a half-time deputy to provide patrol services in the Medicine Lake area. The USFS has cooperative agreements with the Siskiyou and Modoc County Sheriffs departments and California Highway Patrol (CHP) for law enforcement activities on the forests (Reed 1997, pers. com.).

Police protection services in Siskiyou County are provided by Sheriffs department, CHP, and city police departments. The Siskiyou County Sheriffs Department has an officer assigned to the Medicine Lake area seven days a week during the recreational period. This person serves half-time on the county's Medicine Lake water safety project and half-time providing contracted patrol services for the USFS. There are approximately six officers stationed at the Butte Valley/Tulelake office that could respond to emergencies and provide year-round police services to the project area.

In Modoc County, police protection services are provided by the CHP, the Modoc County's Sheriff Department and the City of Alturas Police Department. The Modoc County Sheriffs Department provides police services throughout the entire County. Police protection in the central Modoc area consists of five officers and a sheriff patrol, while one resident represents the staff for the Big Valley area. Two deputies are assigned to the Newell area. The eastern portion of the project area is located within the Newell service area. The Alturas City Police has full responsibility for law enforcement within the city limits. The department has seven sworn officers (Modoc County 1988).

Fire Protection: The USFS provides fire-fighting services on the Klamath and Modoc National Forests. The USFS fire-fighting program focuses primarily on wildland fires, but also has a limited capacity to fight structural fires. On the Klamath Forest, there are fire engines stationed at Grass Lake and Mt. Hebron, plus two additional reserve engines. Approximately 14 fire-fighters are assigned to these engines during the fire season. The forest also has a water supply truck available (Stout 1997, pers. com.). The Modoc National Forest has two fire engines available, one stationed at Dry Lake and one stationed as part of an interagency agreement at Lava Beds National Monument.

The USFS has cooperative agreements with the National Park Service and California Department of Forestry (CDF) to provide additional fire-fighting services. Engines which could provide fire-fighting assistance on the Klamath National Forest are stationed at Lava Beds National Monument, the Klamath National Refuge, and the CDF office in Macdoel. All of these agencies are primarily equipped to fight wildland fires (Reed 1997, pers. com.).

Siskiyou and Modoc Counties can provide additional fire-fighting services for structural fires on the forest. Fire protection services within Modoc County are provided by twelve fire districts throughout the county. The proposed project is located within the Tulelake Multi-County Fire District. The Tulelake Multi-County Fire District has one firehouse that serves the Newell area (Modoc County 1988).

Emergency Services: Emergency services on the Klamath and Modoc National Forests are provided by a number of agencies. Typically, USFS fire engines are the first to respond to a reported accident or injury, although the CHP also responds to emergencies on forest lands. USFS fire engines are equipped with very basic emergency medical supplies. Once on the scene, fire or CHP personnel assess the situation and determine whether an ambulance or helicopter transport is necessary. There is a volunteer ambulance located in Tulelake. Response time for this ambulance to Medicine Lake would be approximately 45 minutes, but could vary greatly depending on road conditions. Helicopter emergency services are available out of Redding and Klamath Falls, and are coordinated through the state (Reed 1997 pers. com.). The closest hospital to the project area is located at Fall River Mills, approximately 25 miles south of the power plant area. There are also hospitals located in Alturas and Mt. Shasta.

Water and Sanitary Sewer Services

Siskiyou County: In Siskiyou County, approximately 59 percent of the households are served by public or private water systems; the remainder are served by individual water wells. The county does not provide any water services. Each of the nine incorporated cities operates a water system. A few unincorporated communities,

including McCloud, also operate public water systems through community service agencies (Inman 1997, pers. com.).

Approximately 54 percent of the households in Siskiyou County are served by public sewer systems. The remaining households use a septic tank or cesspool for sewage disposal. As with water supply, the county does not provide sewer services, but each of the nine incorporated cities do, as do a few unincorporated communities. (Inman 1997, pers. com.).

Modoc County: Water supply in Modoc County comes almost exclusively from groundwater wells. Approximately 51% of Modoc County households are served by individual water wells (Department of Finance 1990). There are four public water systems within the county located in the City of Alturas, California Pines, Newell, and Cedarville. Several private water companies provide water service to scattered areas new Newell via the city of Tulelake water system (Modoc County 1988).

In general, groundwater supplies within the county are abundant. The water district in Newell has the capacity to serve 10,000 people, 30 times the existing population of Newell. Some areas within the county experience seasonal reductions in groundwater availability. For instance, expansion of the Alturas water system is currently constrained by low water volumes during the summer months. Private wells within the county are not regulated. This has led to localized problems of over concentration of wells and contamination of wells due to improper construction and/or proximity to septic systems.

Approximately 60 percent of Modoc County households use a septic tank or cesspool system for sewage disposal (Department of Finance 1990). The remaining 40 percent of the households are served by five public and two private sewer systems. The public systems are located at Newell, Adin, California Pines, Daphnedale, and Alturas. The City of Alturas sewage disposal plant has a present capacity for 5,000 persons (0.5 million gallons per day capacity) which through heat application can be doubled (Modoc County 1988).

Solid Waste Disposal

Solid wastes are classified into three disposal categories depending on their degree of toxicity:

- Class I Toxic materials that are not regulated under the Resource Conservation and Recovery Act (RCRA) either because the legislation specifically exempts them or because they meet established chemical standards for non-RCRA wastes. Household hazardous wastes are exempted from RCRA and are considered Class I wastes.
- Class II Includes oil contaminated solids and debris, asbestos, and some construction wastes.
- Class III Non-toxic, non-contaminated wastes, such as household refuse, vegetation refuse, paper, etc.

Landfills are similarly categorized based on the level of toxic wastes they can accept. A Class III landfill can accept only Class III waste, but a Class II landfill can accept Class II and Class III waste. Transfer stations accept, consolidate, and sometimes separate

household wastes prior to disposal. Generally, transfer stations do not handle toxic materials. Hazardous materials regulated under RCRA must be processed at a treatment facility prior to disposal.

Siskiyou County: Three Class III landfills are located within Siskiyou County in Mount Shasta, Tulelake, and Yreka (see Figure 2.2-1). In addition to serving the county, the Tulelake landfill also receives solid waste collected on the Klamath National Forest. There is a transfer station in Happy Camp in the western portion of the county. The Tulelake landfill is located closest to the project area. It is currently slated for closure in 2001. If this landfill is closed, disposal would be relocated to the Yreka landfill which is scheduled to close in 2109. Siskiyou County is currently pursuing a plan to expand the Tulelake landfill and postpone closure.

There are no Class I or II landfills within Siskiyou County. In addition, there are no hazardous waste treatment facilities located in the county (Inman 1997, pers. com.). Toxic wastes generated in the county must be shipped to a Class I or II landfill or to a treatment facility outside of the county.

Modoc County: Within Modoc County, there are five Class II landfills, located in Fort Bidwell, Lake City, Cedarville, Eagleville, and Alturas. Modoc County residents also use the Tulelake landfill in Siskiyou County under a cooperative agreement. There are also seven transfer stations located in Canby, Davis Creek, Likely, Willow Ranch, Lookout Area, Adin, and Newell. In addition to serving county residents, the Modoc County solid waste facilities also receive all refuse from Modoc National Forest. Solid waste collection services are only available in Cedarville and Alturas (Modoc County 1988). The Alturas landfill would be the closest to proposed project. In 1988, the Alturas landfill had a projected life of over 100 years (Modoc County 1988).

No Class I landfills or hazardous waste treatment facilities are located within in Modoc County (Modoc County 1988). As with Siskiyou County, hazardous wastes generated in the county must be shipped elsewhere for treatment or disposal.

Utility Systems

Siskiyou County: There are no electrical transmission lines located in eastern Siskiyou County in the vicinity of the proposed project.

Modoc County: Five separate transmission lines are located in the vicinity of the proposed action in western Modoc County. The California Oregon Transmission Project (COTP) 500-kV line is located approximately 5 miles east of Tionesta traveling northeast (Figure 2.2-2). Two 550-kV lines are located approximately 3 miles due east of the COTP line. These two lines are known as the PacificCorp and the US (WAPA) lines, are located within the same transmission line corridor. The BPA Malin-Warner 230-kV line is located approximately 3 miles west of Tionesta and travels northwest. An additional 69-kV line, known as the PacificCorp Line 5, parallels Highway 139 approximately 2.5 miles west of Tionesta.

Public Finance

In both Siskiyou and Modoc Counties, the largest sources of public finance include revenue from taxes, state and Federal aid, licenses and permits, and charges for

services. Table 3.16-3 identifies the sources of revenue for the two counties for the fiscal year 1995-1996.

Table 3.16-3: Sources of Public Finance in 1995-1996

Source	Siskiyou County	Modoc County
Taxes and penalties	$9,133,507	$3,232,578
State and Federal revenues	41,190,279	11,435,959
Other government agencies	1,918,921	588,638
Fees for services	3,263,503	485,774
Other	963,359	1,866,056
Total	$56,388,569	$17,609,005

SOURCE: Siskiyou County 1997b; Modoc County 1997b

ALTERNATIVES

The existing socioeconomic conditions described for the proposed action are the same as described for the regional area and thus are the same for each of the alternatives.

4: ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

4: ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

4.1 Introduction

This chapter describes the potential environmental effects of the alternatives, including the proposed action. Similar to the previous chapter of this document (Chapter 3, Affected Environment), this chapter is organized by environmental parameter. For each parameter, key issues for the project are first identified. The applicable regulatory framework and significance criteria are then identified. Significance criteria for each parameter are based primarily on Appendices G and I of CEQA, Federal and state regulations, and project-specific criteria established for this EIS/EIR.

The potential environmental consequences and mitigation measures for the proposed action are then discussed. For each environmental impact of the proposed action, the effect and its significance are described, and any necessary mitigation measures to reduce the effect and its level of significance are identified. Each impact is assigned a number designation (e.g., the first effect discussed in 4.2 Geology and Soils is assigned the designation "4.2.1"). For each impact statement, a summary of the potential impact is followed by a detailed description of the potential effect during each of the three phases of the project (construction, operation, and decommissioning).

In this chapter of the EIS/EIR, a distinction is made between "effects," "adverse effects," and "significant adverse effects." Effects are changes in the environment that would occur as a result of the project, but that would not be considered adverse, and would not be considered significant under CEQA. Adverse effects are effects that would occur as a result of the project, but that would be considered less-than-significant under CEQA. Significant adverse effects are effects of the project that would be considered significant under CEQA.

Recommended mitigation measures for each effect are identified immediately following each impact statement. These measures have been assigned the following designations to clarify which phase of the project they would apply to:

C = Construction phase

O = Operational phase

D = Decommissioning phase

Some mitigation measures would apply to more than one phase of the project; these measures have been appropriately designated. Where applicable, the level of significance of each impact after mitigation is identified immediately following the identification of recommended mitigation measures for each impact. A Mitigation Monitoring and Reporting Program (MMRP) for the proposed action is provided in Chapter 5.

The impact discussion for each environmental parameter also includes a description of potential effects and recommended mitigation measures for each alternative to the proposed action. For Alternatives 2 through 6, potential impacts associated with the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of potential impacts along these portions of the transmission line are not repeated under each alternative discussion. The analysis of the impacts of the alternatives focuses on the effects that would be different from those identified for the proposed action. A discussion of the potential effects of Alternative 7 (the No Action alternative) is also presented for each environmental parameter.

4.2 Geology and Soils

KEY ISSUES

No key issues were identified for geology and soils.

SIGNIFICANCE CRITERIA

Appendix G of the CEQA Guidelines identifies impacts that are normally considered to be significant. Geology-related impacts that would normally be considered significant include:

- Topographic changes which lead to other adverse impacts (e.g., visual impacts or impacts on slope stability)
- Adverse effects on unique geologic or topographic features
- Disrupting or adversely affecting a paleontological site
- Substantial subsidence
- The prevention of the recovery of significant mineral resources
- Exposing people or structures to major geologic hazards
- Causing substantial erosion or siltation

PROPOSED ACTION (ALTERNATIVE 1)

Construction, operation, and decommissioning of the proposed action could affect existing geologic and soil conditions in the project area. In addition, the project could be affected by a variety of geologic hazards. The sections below discuss the potential impacts of the proposed project on topography, unique geologic features, mineral resources, and soil erosion. Effects of geologic hazards on project facilities and personnel are also discussed. These hazards include ground subsidence, seismic activity, volcanic activity, liquefaction, slope instability, and snow avalanches.

4.2.1 Effects on Topography

The proposed action would result in changes to topography during the construction phase through grading and excavation; these changes would be adverse, but not significant. No effect on topography would occur during project operation. The topography of the area would be returned to pre-project conditions (to the extent feasible) during decommissioning.

Construction: The proposed action would require grading for construction of the well pads, pipeline corridors, power plant site, and associated access roads. Grading of these areas would result in approximately 47 acres of surface disturbance (see Table 2.2-1). The waterline would be laid by hand and would not result in any changes to local topography. Leveling of the well pads and power plant site would result in only minimal changes in the topography. The well pads and power plant would be located in a relatively flat area. Localized ground leveling would be achieved through balanced cut and fill. Grading of existing roads and construction of new access roads would also result in minor, localized changes in the topography at the plant development area.

The construction of well pads would require excavation of a 750,000 gallon sump at each of the eight well pad sites. Each sump would be approximately 120 feet by 120 feet,

and 10 feet deep. Sump construction would result in a slight change in the topography at each well site.

Transmission line construction would result in up to 335.8 acres of surface disturbance (see Table 2.2-1) along the transmission line route. This would include minor topographical changes caused by grading of the access roads, substation site, and some of the transmission line structure sites.

The minor topographic changes that would result during the construction phase of the proposed action would not lead to other adverse impacts and would not be significant.

Operation: No changes in topography are proposed to occur during the operation phase of the proposed action; there would be no effect on topography during this phase. Operation would not have a significant effect on topography.

Decommissioning: As part of decommissioning, the project area would be generally returned to pre-project conditions according to the requirements of the USFS. Decommissioning would involve the dismantling of all project facilities, including the power plant, pipelines, well pad equipment, and transmission line. Well pad sumps would be filled in, and areas disturbed and graded by the project would be recontoured to essentially pre-project topography, where necessary and as directed by the USFS. Thus, the decommissioning phase would reduce the effect of the proposed action on local topography and would not result in a significant effect.

Mitigation Measures

No mitigation measures would be required for effects of the proposed project on topography.

4.2.2 Effects on Unique Geologic Features and Paleontological Resources

Construction, operation, and decommissioning of the proposed project would have no impact on unique geologic features in the project area. There are no paleontological resources in the project area, thus there would be no impacts to these resources during any phase of the project.

Construction: The power plant and wellfield would be located adjacent to an SIA, the Pumice Crater Geologic Area. This SIA consists of a series of glass and pumice flows aligned along a northeast vent trend immediately southwest of the proposed wellfield. Well pad P-3 and its associated pipelines would be approximately 200 feet from the edge of the lava flow; well pad P-4 would be approximately 330 feet from the SIA boundary. No construction or operational activities are proposed within the SIA.

The proposed transmission line would be constructed along the margin of two SIAs — the Medicine Lake Glass Flow Geologic Area and the Glass Mountain Glass Flow Geologic Area (Figure 3.2-2). Segment A1 of the proposed transmission line route would pass just south of the Medicine Lake SIA. No access roads would pass through this SIA. There would be no effect on this SIA from construction activities.

Segment A2 of the proposed transmission line would skirt the northwest margin of the Glass Mountain SIA. Approximately 2 miles east of Mt. Hoffman, the transmission line would pass through a gap in the SIA. At this location, a spur of lava extends to the

northwest, and is separated from a small outlying patch of lava by several hundred feet. The Glass Mountain SIA includes both the spur of lava and the outlying patch, but does not include the space between the two (see Figure 3.2-2). The proposed transmission line would pass through this gap, and would not cross the lava flow or the boundary of the SIA. No access roads would be constructed within the Glass Mountain SIA. There would be no effect on the Glass Mountain SIA from construction of the proposed project.

Operation: Operation of the proposed project would not involve any activities within the existing SIAs in the project area. Therefore, no impacts to these features would result from operation of the proposed action.

Decommissioning: Decommissioning of the proposed project facilities would not involve any activities within the existing SIAs in the project area. Therefore, no impacts to these features would result from the decommissioning phase of the proposed project.

Mitigation Measures

The following mitigation measures are recommended to ensure that there are no impacts to any Geologic SIAs.

4.2.2a Calpine shall not undertake project activities within any established SIA. Calpine shall define in the field with a USFS representative the limits of project activities and surface disturbance for facilities proposed near SIAs to ensure that inadvertent damage to SIAs does not occur. The limits of surface disturbances shall be marked by stakes and flags prior to construction. (C)

Level of Significance After Mitigation

Less than significant.

4.2.3 Mineral Resources

The construction, operation, and decommissioning of the proposed project facilities would not affect mineral resources or mineral extraction activities in the project area.

Construction: The power plant and wellfield would not impact mineral resources; facilities would not be located near any known or active mineral extraction sites. The nearest basaltic cinder cones that could be used for road materials are located approximately 0.5 miles south of the power plant. The proposed action would not interfere with mineral extraction that could occur at this location. The proposed transmission line and associated access roads would not pass through cinder cones or prevent any mineral sources from being recovered. There are a large number of cinder cones in the area and the availability of potential extraction sites in the area greatly exceeds the demand for road materials.

Construction of the proposed project would not interfere with future extraction of minerals from areas covered by currently unpatented mining claims. Well pads P-3, P-4, and P-5 in the southwest corner of Section 28 would occupy approximately 7.5 acres of land. Future pumice mining activities would be precluded at these well pads and along project area roads; however, less than ten percent of the area covered by the mining claim for the southwest corner of Section 28 would be affected. This effect would not be significant. Construction of transmission line segments A2 and B1 would not affect future mineral extraction activities in the vicinity of these segments.

Operation: For the same reasons described above, operation of the power plant and wellfield and the maintenance of transmission line would not impact the availability of mineral resources or interfere with their extraction.

Decommissioning: For the reasons described under the construction phase, decommissioning of the proposed facilities would not impact the availability of mineral resources or interfere with their extraction. There would be no impacts to mineral resources as a part of facility decommissioning.

Mitigation Measures

No mitigation measures would be required for effects of the proposed project on mineral resources.

4.2.4 Ground Subsidence

The proposed action could result in ground subsidence (see Section 3.2) as a result of withdrawal of geothermal fluid from the geothermal reservoir during the operation phase. Due to the nature of the reservoir and operational methods, minimal subsidence is expected. The impact would be adverse, but not significant. No ground subsidence is expected to occur as a result of the construction or decommissioning phases of the project.

Construction: During the construction phase of the proposed project, very little fluid would be withdrawn from the geothermal reservoir during well drilling and testing of the reservoir. No ground subsidence is expected to occur as a result of geothermal fluid withdrawal during construction of the project.

Land subsidence can occur where large quantities of water are withdrawn from the subsurface, especially in aquifers composed of unconsolidated sediments. During the 33-month construction phase, approximately 21.3 million gallons of water would be drawn from the shallow groundwater system for well drilling and facility construction (see Section 4.3, Hydrology for details). During the first year of construction, water would be supplied from a well in the Arnica Sink area. During the second and third years of construction water would be supplied from a well on Calpine's leases. Peak water withdrawals would occur during the last year of construction and could be up to 8.5 million gallons per year.

Water withdrawals from the Arnica Sink well would be small relative to the amount of water in the local groundwater system, as well as to the annual rate of groundwater recharge (see Section 4.3, Hydrology for details). Due to the relatively small amount of groundwater that would be withdrawn and the short time required to recharge the groundwater resource, ground subsidence in the Arnica Sink area would not be expected to occur. Water withdrawals from the well on Calpine's leases would also be small relative to the size of the local groundwater resource and the annual recharge rate. In addition, the shallow groundwater aquifer in the power plant and wellfield area is probably composed mainly of volcanic flows. Volcanic flows usually consist of competent rocks that do not compress, making subsidence unlikely. Based on the relatively small amount of groundwater that would be withdrawn and the geology of the lease area, shallow groundwater pumping from a well on Calpine's land would not

be expected to result in subsidence. If subsidence were to occur at either well location, there are no facilities in the project area that would be affected.

Operation: During the operation phase of the proposed action, geothermal fluid would be withdrawn from the geothermal reservoir and could result in localized ground subsidence in the vicinity of the wellheads, and no subsidence is expected outside the wellfield. Ground subsidence has been observed in some geothermal development areas, particularly where geothermal reservoirs occur in sedimentary basins or in high porosity volcanics (such as lavas or some types of pyroclastic deposits), and where the spent geothermal fluid is not returned to the reservoir.

Subsidence as a result of production of geothermal fluids would be minimal for the following reasons:

- The underlying geothermal system is hosted by fractured igneous and metamorphic rocks and there is probably no fluid-supported aquifer material.
- Approximately 80% of the geothermal fluids withdrawn from the reservoir would be injected back into the geothermal system minimizing the net loss of subsurface mass (see Section 4.4, Geothermal Resources).
- Production of geothermal fluids is anticipated to be primarily from deep subsurface fracture systems. This would reduce the horizontal extent of fluid withdrawal and therefore the area available for subsidence.

Some localized subsidence could occur around individual production wells if production depths are significantly shallower than anticipated and groundwater levels are lowered in the immediate vicinity of the well. The likelihood of this occurring is low. If subsidence were to occur, it would be minimal and localized to the wellfield.

GRO No. 4 would serve to mitigate any subsidence impacts which do occur. GRO No. 4 requires surveys of ground elevations both prior to and during geothermal resources production to determine whether ground subsidence is occurring in the wellfield or in adjacent areas. If the surveys show that subsidence resulting from production activities is occurring and the BLM Authorized Officer determines that this subsidence presents a significant hazard to operations or adjoining land use, then GRO No. 4 states that the Authorized Officer may require remedial action including, but not limited to, reduced production rates, increased injection of waste or other fluids, or a suspension of production.

Minimal, localized subsidence would be an adverse, but not significant impact because it would not be expected to affect any public or project facilities. These impacts would be further mitigated by the requirements of GRO No. 4.

Water use during the operation phase of the project would not be expected to exceed that for construction. For the same reasons described above for the construction phase, withdrawal of shallow groundwater would not result in any ground subsidence during the operational phase of the project.

Decommissioning: No fluids would be withdrawn from the geothermal reservoir during decommissioning; subsidence due to withdrawal of geothermal fluids would not occur. Groundwater use during decommissioning would not be expected to exceed

that for construction. For the reasons discussed above, subsidence due to groundwater withdrawal would not be expected.

Mitigation Measures

Subsidence as a result of the proposed action is expected to be minimal, and no mitigation measures are recommended.

4.2.5 Seismic Activity

The proposed action would expose people and structures to both natural and potential induced seismic hazards. Most of the potential effects would be associated with the operation phase of the proposed action. Effects of natural and induced seismic activity in the project area would be adverse, but not significant.

Construction: Natural seismic activity could present a hazard to Calpine employees and project facilities. Seismic activity in the project area could result in ground shaking, ground settlement, liquefaction, and seismically induced landslides which could present a hazard to people and structures during the construction phase of the proposed action. It is expected that drilling and well testing equipment would not be excessively hazardous during an earthquake (BLM et al. 1995). In addition, historic seismic activity in the project area has been of fairly low magnitude and this would be expected to continue through the project's lifespan. Due to the low magnitude of expected seismic activity in the project area and the limited hazard posed by construction equipment and facilities during an earthquake, impacts during this phase of the project as a result of seismic activity would be adverse, but not significant.

Withdrawal or injection of large amounts of fluid from the geothermal reservoir could cause increased seismic activity in the project area. Drilling and testing operations during the construction phase of the proposed project would not result in induced seismic activity since only small amounts of fluid would be withdrawn from the reservoir during this phase.

Operation: The potential effects of severe ground shaking during the operation phase of the proposed action would include damage to the proposed power plant and wells, blowouts in the wellfield, rupture and/or offset of the pipelines, and offset or breach of the sumps. In general, ground shaking in the plant development area is not expected to damage subsurface well casings with industry-standard cementing programs and with proper compaction of well pad surfaces. The potential effects of ground shaking on the transmission line include outages due to arcing between the conductors, pole movement, and structural collapse. Due to the low magnitude of expected natural seismic activity in the project area, impacts during the operation phase of the proposed action would be adverse, but not significant.

In addition to natural seismic activity, there is the potential for induced seismic activity during the operation phase of the proposed action. The proposed project could induce microseismic activity in the area by either the withdrawal or injection of geothermal fluids. Other geothermal production areas have experienced increased seismic activity in the magnitude range of 1 to 3 on the Richter scale as development proceeded. These event magnitudes are too low to be felt by humans and are not of concern to the safe operation of the project. Any increased seismic activity in the project area caused by

geothermal development would be of low magnitude and would not be expected to damage project or other facilities. Therefore, the effects of increased seismic activity would not be significant.

Decommissioning: The effects of natural seismic activity would be similar to those described for the construction phase. For the reasons described above, the impacts of seismic activity during the decommissioning phase would be adverse, but not significant.

Mitigation Measures

The impacts of seismic activity would not be significant, and no mitigation measures are recommended. Calpine would follow all federal, state, and local seismic codes in construction of project facilities, which would minimize any impacts from seismic activity.

4.2.6 Volcanic Activity

Operation of the proposed project is not expected to induce volcanic activity in the project area; however, the proposed action would expose people and structures to risk from a potential natural volcanic eruption. Hazards to workers as a result of volcanic activity would be considered extremely remote and therefore not significant. The hazards of natural volcanic activity would be generally the same in all three phases of the proposed action.

Construction: Potential hazards from volcanic activity include lava and mud flows, release of volcanic gases and ashes, phreatic explosions, debris avalanches, extensional ground cracking, and flooding from snowmelt (BLM et al. 1995; USFS 1994b). Based on historical eruptions in the Medicine Lake Highlands, a volcanic eruption in the project area would not be expected to be violent. An eruption would be accompanied by gases and deposits of ash, pumice, and cinders. The erupted materials deposited could be 20 to 50 feet deep in the project area, depending on the distance from the source of the eruption. Surface flows of hot molten lava and mud would not be expected to be extensive. As mud flows are ejected from a volcano, they pick up more water as they melt snow, slide through lakes, and eventually flow down existing drainages. Mud flows occurring as a result of an eruption in the Medicine Lake Highlands would not be extensive because few drainages exist in the area.

Although the USGS and the California Division of Mines and Geology have been monitoring volcanic and seismic activity near Mount Shasta (USFS 1994b), such monitoring does not guarantee that eruptions will be predicted with adequate warning to allow evacuation of project facilities. No formal multi-agency emergency response plans exist for eruptions in the Medicine Lake area; in the event of an eruption, USGS would be the lead agency and would establish hazard zones (USFS 1991). If there is any indication during the life of the proposed action that a volcanic eruption is imminent in the vicinity of the proposed action, Calpine would comply with employee evacuation procedures specified by the USGS, USFS, and BLM. Volcanic events would not be expected to affect wells. Due to the infrequency of volcanic eruptions and the extremely low probability of one occurring during the construction phase of the proposed action, the effects of volcanic activity during this phase would not be considered significant.

Operation: The effects of natural volcanic activity during the operation phase would be similar to those described for the construction phase. For the reasons described above, the impacts of natural volcanic activity during the operation phase would not be considered significant.

It is unlikely that drilling, development, and production of the geothermal wells would induce either volcanic or hydrothermal explosions. The movement of magma is controlled by tectonic forces which are orders of magnitude greater than the slight changes in fluid pressure which may result from geothermal development. Thermal explosions result when the fluid pressure within the geothermal reservoir becomes greater than the weight of the overlying rock (lithostatic pressure). This condition is most likely to occur in shallow reservoirs where the rock pressure is low. In the Glass Mountain KGRA, the geothermal reservoir lies several thousand feet below the surface and lithostatic pressures are more than adequate to suppress hydrothermal eruptions.

Decommissioning: The effects of natural volcanic activity during decommissioning would be similar to those described for the construction phase. For the reasons described above, the impacts of natural volcanic activity during the decommissioning phase would not be considered significant.

Mitigation Measures

No mitigation measures would be required for effects of volcanic activity.

4.2.7 Liquefaction

Liquefaction of soils (see Section 3.3) at the power plant, well field, or along the transmission line could cause damage to project facilities and interrupt project operations. However, the primary requirement for liquefaction to occur is that soils be saturated, and current investigations indicate that nowhere in the project area does this condition exist close to the surface. Therefore, effects of liquefaction would not be significant during any phase of the project.

Construction: Soil conditions at the power plant site, wellfield, and along most of the transmission line are not susceptible to liquefaction. A portion of segment A1 passes through an area meeting the criteria for wetlands located between Medicine Lake and the Medicine Lake Glass Flow. This area would have an increased potential for liquefaction if soils in the immediate area were granular and saturated. This wetland area is comparatively small and localized. Another portion of segment A1 in the vicinity of Arnica Sink also has an increased potential for liquefaction during an earthquake if the sediments there were saturated (Calpine 1995; USFS 1982; USFS and SCS 1983). However, since the depth to the groundwater in this area is approximately 200 feet, soils are not likely to be saturated and liquefaction would not be expected to occur. The likelihood of liquefaction along segment A1 is considered remote, and therefore the effect would not be significant.

Operation: The potential for liquefaction during the operation phase is the same as described above for the construction phase, and effects would not be significant.

Decommissioning: The potential for liquefaction during the decommissioning phase is the same as described above for the construction phase; effects of decommissioning would not be significant.

Mitigation Measures

The potential for liquefaction in the area is low. Liquefaction is not expected to cause significant effects and no mitigation measures are required. Calpine would follow all federal, state, and local standards and codes for construction of transmission lines which would minimize any impacts from liquefaction.

4.2.8 Slope Instability

The proposed action could have an effect on or be affected by the downslope movement of rock and soil if steep-sided volcanic slopes are developed. Due to the low probability of slope instability in the project area and transmission line construction standards, effects of slope instability along the transmission line adverse, but not significant during the construction, operation, and decommissioning phases.

Construction: Construction of the proposed project would not have an effect on or be affected by unstable slopes because power plant would be located in a relatively flat area. Portions of the proposed transmission line would pass through areas of steep terrain where slope instability could be a hazard. Segment A2 of the proposed transmission line route south of Indian Butte is of particular concern because it traverses slopes of 50 to 100 percent (USFS 1982; USFS and SCS 1983). Construction of access roads along this segment could cause some slope instability. The clearing of vegetation along the transmission line corridor and access roads would slightly increase the potential for slope instability. Due to the low potential for slope instability and the limited risk posed to people and structures as a result of slope instability, effects of instability would not be significant during the construction phase of the proposed action.

Operation: The potential for slope instability during the operation phase would be the same as described above for the construction phase. Potential effects of unstable slopes along the transmission line corridor during the operation phase of the project include line breakage, pole movement, and structural collapse. Due to the low potential for slope stability and required construction guidelines, effects of slope instability during the operation phase would be adverse, but not significant.

Decommissioning: The potential for slope instability during the decommissioning phase of the project are the same as those described above for the construction phase. Due to the low potential for slope stability and the limited risk to people and structures, effects of slope instability during this phase of the proposed action would be adverse, but not significant.

Mitigation Measures

The potential for slope instability in the area is low and is not expected to cause significant effects.. Calpine would follow all federal, state, and local standards and codes for construction of transmission lines which would minimize any impacts from slope instability. The following mitigation measure limits the construction of new roads

in this area of segment A2 and mandates that maximum use of existing roads in the area:

4.2.8a If a transmission line alignment is chosen that includes segment A2, roads will not be constructed on the steep north slopes of Glass Mountain. The distance between transmission poles in this area will be maximized in order to accomplish this goal. Existing roads will be used in this area to the maximum extent possible.

4.2.9 Snow Avalanches

There is a low potential for snow avalanches along a portion of segment A2 of the proposed transmission line. Due to the low probability of a snow avalanche and transmission line construction standards, impacts of snow avalanches during the three phases of the project would be adverse, but not significant.

Construction: The plant development area and the majority of the proposed transmission line route would not be located in potential snow avalanche areas. However, due to the combination of tall and steep slopes, there is a potential for snow avalanches along a portion of segment A2 of the proposed transmission line south of Indian Butte. The potential for snow avalanches along this segment could be slightly increased by the clearing of vegetation along the transmission line corridor. Due to the low probability of a snow avalanche and the limited risk to people and structures, effects of snow avalanches along segment A2 of the transmission line would be adverse, but not significant during this phase.

Operation: The potential for snow avalanches during the operation phase are the same as those described above for the construction phase. An avalanche along segment A2 of the transmission line could cause pole movement or structural collapse, interruption of the supply of electricity, and/or possibly create an electrocution hazard. Due to the low potential for snow avalanches and required construction guidelines, effects of slope instability during the operation phase would be adverse, but not significant.

Decommissioning: The potential for snow avalanches during the decommissioning phase of the project are the same as those described above for the construction phase. Due to the low probability of a snow avalanche and the limited risk to people and structures during decommissioning, effects of slope instability would be adverse, but not significant during this phase of the proposed action.

Mitigation Measures

The potential for snow avalanches in the area is low and is not expected to cause significant effects. No mitigation measures are required. As stated above, Calpine would follow all applicable standards and codes for construction of transmission lines which would serve to minimize any impacts from snow avalanches.

4.2.10 Effects on Soil Erosion

The proposed action would result in minor increases in soil erosion rates through grading and other construction activities, these changes would be adverse, but not significant. Undetected rupture of the water supply line from Arnica Sink could result in significant erosion during the construction phase. Minimal impacts to soil erosion would occur during the operation phase of the project as a result of road snow plowing. Decommissioning activities could result in minor, short-term increases in erosion.

Construction: Construction of the proposed project could cause increased soil erosion as a result of surface disturbance and removal of vegetation. During the construction phase, the wells pad sites, power plant site, access roads, substation site, and some of the transmission line structure sites would be graded. Vegetation would be removed in these areas, as well as along the transmission line corridor. The proposed project would involve approximately 75 acres of surface disturbance and 261 acres of vegetation removal along the transmission line (see Table 2.2-1). Of the 261 acres that would be subject to vegetation removal, approximately 136 acres would be reseeded.

In general, erosion potential in the power plant and wellfield area and along the transmission line corridor is relatively low because the high porosity of soils in the project area reduces runoff potential. Erosion potential would be highest on steep, sparsely vegetated slopes, in fine sandy and silty soils, and during periods of high precipitation. In order to prevent or reduce the amount of soil erosion caused by construction activities described above, Calpine has proposed the following soil erosion control measures:

- Project construction would include culverts, berms, and ditches to direct runoff and minimize erosion potential. This would include a berm around each well pad and the power plant site.
- Cut and fill slopes would be engineered, compacted, and maintained to provide slope stability and minimize erosion.
- A drainage plan involving gathering channels would be developed, as necessary, along excessive sloped access and maintenance roads. This plan would be installed so that surface water run-off can be conveyed to normal waterways and prevent undue erosion.
- Road maintenance designed to reduce the erosion potentials would consist of grading roadways, cleaning ditches and culvert openings, controlling vehicle travel during wet seasons, and periodic patrols of roads to stop potentially serious damage.
- In order to prevent undue erosion and runoff, Calpine would use existing roads wherever possible.
- As soon as the construction phase of the proposed action is complete, all cut and fill slopes, as well as any disturbed level areas, would be seeded or planted with native grasses and/or shrubs, as directed by USFS.

As a result of the natural permeability of project area soils and the control measures proposed by Calpine, the impacts of construction activities described above would be adverse, but not significant.

During the winter months of the construction phase, snow from the plowing of access roads may be stockpiled in cleared areas. If the snow is stockpiled on areas where the soil has been removed, increased soil erosion during spring snowmelt could occur. Due to the high permeability of soils in the project area, increased soil erosion caused by melting of stockpiled snow would not be expected to be significant.

Soil erosion could also occur during the first construction season if the water supply pipeline from Arnica Sink were to leak or rupture. If undetected, rupture of this pipeline could cause significant localized erosion.

Excessive runoff caused by a well blowout could cause increased erosion during the construction phase. Blowouts are accidental, uncontrolled releases of geothermal fluids such as steam, gases, or hot water from a geothermal well during drilling operations. The few recorded well blowouts in the U.S. were caused by either drilling into shallow, over-pressured reservoirs without taking adequate precautions, or by drilling into active landslides (Darr 1997). The risk of a blowout during proposed drilling operations at the well pads would be considered low. The reservoir is expected to exist at a depth of 6,000 feet or more, and wells would be drilled in the highly competent, volcanic rocks that are not very prone to well blowouts. There are no known potential landslide areas in the vicinity of the power plant and wellfield site. In addition, a Blowout Contingency Plan would be implemented as part of the proposed drilling program, including installation of blowout prevention equipment, control procedures, periodic equipment testing, notification procedures, and lists of media contacts. These measures would minimize the potential for blowouts.

In the unlikely event that a blowout did occur, released fluids would be partially contained by the sump and the berm surrounding the well pad. This would reduce the amount of runoff and associated erosion. Based on the low probability of blowout occurring and the runoff controls at each well pad, impacts on erosion from a well blowout would be adverse, but not significant. (See Section 4.15, Human Health and Safety for information on the impacts of well blowouts on humans).

Operation: During the operation phase of the proposed project, localized soil erosion could occur as a result of an undetected pipeline leak or rupture. However, it is probable that a leak or rupture of one of these pipelines would quickly be detected by the power plant operators and treated. Therefore, effects of soil erosion due to pipeline rupture during the operation phase would not be expected to be significant.

As described under the construction phase, stockpiling of plowed snow on disturbed areas could result in increased soil erosion. This practice could result in significant localized erosion during the operation phase.

A well blowout could potentially occur during the operation phase of the proposed project. For the reasons described under the construction phase, the effects of a blowout on soil erosion would be adverse, but not significant.

Decommissioning: During decommissioning, disturbed areas would be recontoured, if necessary, and revegetated. These activities would reduce any project impacts on soil erosion rates.

Mitigation Measures

4.2.10a Calpine shall develop a comprehensive Soil Conservation and Erosion Control Plan (SCEC) for the proposed project in consultation with the USFS and BLM prior to issuance of a permit. This plan shall describe measures to reduce erosion in all three phases of the project. In addition to the control measures already identified by Calpine, the SCEC shall include, but is not limited to, the following control measures:

- Soil disturbance shall be limited to the amount necessary for construction and access.
- Vehicular traffic associated with the project shall be restricted to access roads and construction clearings.

- Grading and other surface disturbance activities shall be scheduled to avoid periods of heavy precipitation.
- The time between surface disturbance and revegetation shall be minimized.
- Detention basins, straw bales, or silt fences shall be used where appropriate.
- Where transmission line construction occurs along steep slopes (greater than 15 percent), special soil handing measures shall be implemented, including replacing topsoil and leaving the seedbed rough and using mulch or erosion-control matting.
- New access roads shall incorporate erosion-reduction measures such as water bars, outsloping, road ditches, and rock-lined drainages.
- The water supply pipeline shall be monitored for leaks throughout the first construction season and removed at the end of this period.

If the USFS determines that significant increased soil erosion is occurring as a result of the proposed project, Calpine shall implement additional control measures as directed by the USFS. (C,O,D)

Impacts on soil erosion would also be reduced by revegetation plans outlined in Mitigation Measure 4.7.1a.

Level of Significance After Mitigation

Less than significant.

4.2.11 Effects of Deposition of Air Emissions

During the construction and operation phase of the proposed project, air emissions would be released from the power plant and wells (see Section 4.13, Air Quality). These emissions would have a minor effect, but not significant impact on project area soils. During the decommissioning phase, no emissions would be released from the power plant or wellfield, and therefore there would be no effect from deposition on project area soils.

Construction: During the construction phase of the proposed project, air emissions would be released during well venting and testing. These emissions would be composed of gases, including water vapor and noncondensible gases, and droplets of water. The water droplets would contain dissolved and suspended solids, including heavy metals. The largest droplets would fall to the ground in the vicinity of the power plant and cooling tower. The smallest droplets may evaporate with the suspended and dissolved solids they contain forming aerosol particles which are dispersed over a wide area. The emissions would be temporary, but could last up to 90 days per well.

Soils in the project area would be expected to have a similar mineral makeup as the solids in the air emissions because both are derived from similar volcanic rocks. Because of this similarity, deposition of project air emissions would not be expected to substantially change the composition of soils in the project area. The impact of the deposition of air emissions on project area soils during this phase would not be significant. Analysis of the impacts of deposition of air pollutants on vegetation found that plants would not be significantly impacted through either direct deposit or uptake through the roots (see Section 4.7, Vegetation). The effects on water quality of pollutants

deposited on soils and transported to surface water by runoff are addressed in Section 4.3, Hydrology.

Operation: During the operational phase of the proposed action, air emissions would be released from the cooling tower and plant silencers (see Section 4.13, Air Quality for more information). The emissions would have a similar makeup as those released during the construction phase. Well venting emissions would also occur in this phase. For the same reasons described above, the impact of the deposition of air emissions on project area soils during this phase would be adverse, but not significant.

Decommissioning: No air emissions other than dust would be emitted during the decommissioning phase. There would be no effect on project soils from the deposition of air emissions during this phase.

Mitigation Measures

The effects of deposition of air pollutants on project area soils would not be significant, and no mitigation measures are recommended.

ALTERNATIVES

The following section describes potential effects and recommended mitigation measures for each alternative to the proposed action. For Alternatives 2 through 6, potential impacts associated with the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of potential impacts along these portions of the transmission line are not repeated under each alternative discussion. The analysis of these impacts focuses on the effects that would be different from those identified for the proposed action.

Alternative 2 (Segments A1, A2, B1, and C2)

Alternative 2 differs from the proposed action by the substitution of transmission line segment C2 for segment C1 and a correspondingly different location of the substation at the end of the transmission line. The effect of Alternative 2 on geology and soils, and the level of significance of the impacts would be generally the same as for the proposed project.

Similar to transmission line segment C1, segment C2 is not susceptible to slope instability or snow avalanche. Soils along segment C2 near Dry Lake may be saturated at times; however, they are unlikely to experience liquefaction during an earthquake because the soils are shallow and clayey. Potential volcanic and seismic hazards under this alternative would be the same as those described for the proposed action. The effects on unique geologic features, paleontological resources, mineral resources, and soil erosion rates would similar to those described for the proposed project.

The mitigation measures identified for the proposed project would apply to Alternative 2 as well. All of the impacts would be less than significant after mitigation.

Alternative 3 (Segments A1, B2, and C1)

Alternative 3 differs from the proposed action by the substitution of transmission line segment B2 for segments A2 and B1. This transmission line route extends south of Red Shale Butte and Lyon's Peak before heading north to connect with segment C1. The effect of Alternative 3 on geology and soils, and the level of significance of the impacts would be generally the same as for the proposed project.

Under Alternative 3, the potential effects of slope instability and snow avalanche along segment A2 would be avoided; however, portions of segment B2 are also susceptible to slope instability and snow avalanche. The effects of slope instability and/or snow avalanches along segment B2 would be similar to those described for segment A2 under the proposed action. These effects would not be significant.

All of the mitigation measures identified for the proposed action would also apply to Alternative 3. The impacts would be less than significant after mitigation.

Alternative 4 (Segments A1, B2, and C2)

Under Alternative 4 segment B2 would replace segments A2 and B1, and segment C2 would replace segment C1. Alternative 4 is the same as Alternative 3 except that the transmission line follows segment C2 north to avoid Tionesta, rather than following segment C1. The effect of Alternative 4 on geology and soils, and the level of significance of the impacts would be generally the same as for the proposed project.

Similar to Alternative 3, Alternative 4 would avoid the potential impacts of slope instability and snow avalanche associated with transmission line segment A2. However, portions of segment B2 would also be susceptible to slope instability and snow avalanche. The effects of slope instability and/or snow avalanches along segment B2 would be similar to those described for segment A2 under the proposed action. These effects would not be significant. Although soils along segment C2 near Dry Lake may be saturated at times, they are unlikely to experience liquefaction during an earthquake due to the shallow, clayey soils.

All of the mitigation measures identified for the proposed action would also apply to Alternative 4. The impacts would be less than significant after mitigation.

Alternative 5 (Segments A3, B1, and C1)

Alternative 5 differs from the proposed action by the substitution of transmission line segment A3 for segments A1 and A2. Segment A3 extends north from the power plant, passing to the west of Fourmile Hill. It then heads east following a route to the north of Mt. Hoffman. The effects and level of significance of Alternative 5 on geology and soils would be generally the same as for the proposed project.

Under Alternative 5, the impacts associated with transmission line segments A1 and A2 would be avoided. These impacts include potential liquefaction along segment A1 and potential slope instability and snow avalanche along segment A2. Based on soil and topographical characteristics, segment A3 would not be susceptible to slope instability, snow avalanches, or liquefaction. Therefore, the impact of these hazards would not be significant under Alternative 5.

Although none of impacts on geology and soil under Alternative 5 would be significant, the mitigation measures identified for the proposed action would still apply to this alternative.

Alternative 6 (Segments A3, B1, and C2)

Under Alternative 6, segment A3 would replace segments A1 and A2, and segment C2 would replace segment C1. Alternative 6 is the same as Alternative 5 except that it follows segment C2 north to avoid Tionesta, rather than following segment C1. The effects and level of significance of Alternative 6 on geology and soils would be generally the same as for the proposed project.

Similar to Alternative 5, Alternative 6 would avoid the impacts associated with transmission line segments A1 and A2. These impacts include potential liquefaction along segment A1 and potential slope instability and snow avalanche along segment A2. Based on soil and topographical characteristics, segment A3 would not be susceptible to slope instability, snow avalanches, or liquefaction. Therefore, the impact of these hazards would not be significant under Alternative 6.

Although none of impacts on geology and soil under Alternative 6 would be significant, the mitigation measures identified for the proposed action would still apply to this alternative.

Alternative 7

Geology and soils would not be affected by the implementation of Alternative 7, the No Action alternative. No mitigation measures would apply to this alternative.

4.3 Hydrology

REGULATORY FRAMEWORK

The California Regional Water Quality Control Boards (RWQCB) with oversight from the State Water Resources Control Board are responsible for protecting water quality (both surface water and groundwater) in California. Most of the project area falls under the jurisdiction of the North Coast RWQCB. Portions of transmission line alternative routes A1, A2, and B2 traverse land under the jurisdiction of the RWQCB Central Valley Region. Proposed activities that are regulated by the RWQCB include discharges of drilling fluids and geothermal fluids to well pad sumps, surface transportation of fluids, and any other activity likely to cause impacts to surface or ground waters. Calpine Corporation would be required to submit a Report of Waste Discharge, and would need the approval of the North Coast RWQCB prior to discharging fluids to the sumps.

Although the transmission line would not cross any perennial streams, construction of the transmission line across intermittent stream channels may require a Stream and Lake Alteration Permit (1603) from the California Department of Fish and Game. A Section 404 permit from the U.S. Army Corps of Engineers could also be required if the transmission line passes through an area which meets the criteria for a jurisdictional wetland.

Injection of spent geothermal fluids and treated sewage wastes into injection wells is regulated by the U.S. Environmental Protection Agency Underground Injection Control Program. The BLM acts on behalf of the EPA for permitting, monitoring, and ensuring proper construction and maintenance of those wells. BLM is also responsible for permitting and monitoring geothermal production wells.

All activities associated with the project would also be conducted in accordance with applicable regulations, guidelines, and generally accepted best management practices, including those in the Water Quality Control Plans for the North Coast and Central Valley Regions. These Water Quality Control Plans, or Basin Plans, apply to Calpine's Fourmile Hill leases and the proposed and alternative transmission line routes, and include objectives, guidelines, and policies to prevent the degradation of surface waters and groundwater. Applicable portions of the plans include guidelines and policies regarding:

- Waste discharge prohibitions
- On-site waste treatment and disposal practices
- Action plans for accidental spills and contingencies
- Power plant cooling
- Action plans and discharge prohibitions for construction activities

As discussed in Section 3.10, Plans and Policies, the Northwest Forest Plan (USFS and BLM 1994) established a land management category called Riparian Reserves and defined management standards and guidelines for these areas. The standards and guidelines for Riparian Reserves are included in the Klamath National Forest LRMP (USFS 1994a) and were added by amendment to the Modoc National Forest LRMP

(USFS 1991a). These standards and guidelines are designed to protect the riparian environment, including both the aquatic system and the surrounding vegetation.

KEY ISSUES

The key hydrology issues identified and evaluated in this section relate to the effects of the project on the water quality and quantity at Medicine Lake, as well as regional water quality and quantity. These effects are evaluated in Impacts 4.3.2, 4.3.6, 4.3.7, 4.3.8, and 4.3.9.

SIGNIFICANCE CRITERIA

Significant impacts of the proposed action on the hydrology of the area could include:

- Changes to the amount of water in any surface body
- Substantial depletion or degradation of groundwater resources
- Interference with groundwater recharge
- Increased substantial flooding, or exposure of people or property to water-related hazards
- Degradation of stream channels
- Contamination of a public water supply
- Substantial degradation of water quality

METHODOLOGY

Project activities were evaluated to assess their impacts on surface water and groundwater resources. Water use by the proposed project activities was estimated and compared to estimates of the amount of available groundwater and the rate of groundwater recharge. Changes in surface runoff patterns were estimated based on expected changes in vegetation coverage at the power plant and wellfield area, and along the transmission line corridor. Project activities were also evaluated to determine potential sources of air emissions which might result in a degradation of water quality in surface water or groundwater in the project vicinity.

PROPOSED ACTION (ALTERNATIVE 1)

Construction, operation, and decommissioning of the proposed project could potentially impact surface water or groundwater. Potential sources of impacts include pumping of shallow groundwater wells for project water needs, drilling of geothermal wells, production and injection of geothermal fluids, altered surface runoff patterns, and deposition of cooling tower emissions. Impacts could also occur in the unlikely event that a well-blowout or pipeline rupture released geothermal fluids or in the event of accidental spill of chemical or hazardous materials. Mitigation measures are available to minimize or eliminate all of the potential impacts.

4.3.1 Effect of Water Use

The proposed action would require water primarily for well pad and power plant construction, drilling of production and injection wells, initial supply of cooling water, and domestic uses. Maximum projected water usage during the construction phase could have a temporary, but not significant, effect on local groundwater supplies. No

significant effects would result from project water usage during the operation or decommissioning phases.

Construction

Estimated Water Usage: The total volume of water that would be required during the 33-month construction phase of the proposed project is estimated at approximately 24.3 million gallons (74.6 acre-feet). Table 4.3-1 provides water use information for construction activities. Peak water usage would occur during the last year of construction and would be approximately 10 million gallons per year. During the first season of drilling, water would be supplied via pipeline from wells located at Arnica Sink. During the second and third years of construction, water would be supplied from a well drilled on Calpine's Fourmile Hill geothermal leases. In both well locations, the water supply for the proposed project would be pumped from the shallow groundwater aquifer. There is no proposed use of surface water for the project. Drinking water would be supplied by bottled water (Calpine 1995).

Effect of Water Withdrawals from Arnica Sink Well(s): Water for project activities during the first seven-month long drilling and construction season would be withdrawn from an existing well located at Arnica Sink. Project water use during this first year of construction is estimated at approximately 6.9 million gallons. This well supplied water for previous geothermal drilling in the KGRA. The USGS (1995) reports yields for the Unocal water well at Arnica Sink of 20 gallons per minute, or 10.5 million gallons per year. The well capacity is expected to be adequate for the proposed activities.

Estimated withdrawals from these wells would not significantly reduce groundwater resources in the Arnica Sink area. Given an approximate area for Arnica Sink of 200 acres, 30 inches of precipitation annually, and a typical evaporation rate for areas with similar climate and vegetation of 50 percent, groundwater recharge to Arnica Sink from the immediate area alone would exceed 80 million gallons annually. Project water use during the first year of construction would be equivalent to approximately 8.5 percent of this estimated annual groundwater recharge from the immediate Arnica Sink area. Withdrawal of 6.9 million gallons during the first year of construction would have a temporary and adverse, but not significant, effect on groundwater resources.

Given the proximity of Arnica Sink to Medicine Lake and the fact that both waterbodies are within the same surface water basin, it is reasonable to assume that there is some subsurface hydrological connection between Arnica Sink and Medicine Lake. Withdrawal of the estimated 6.9 million gallons of water that would be withdrawn from Arnica Sink well(s) during the first construction season would be a small fraction of the amount of annual precipitation which falls directly into Medicine Lake and would not significantly affect the lake. Assuming a lake surface area of 425 acres and a precipitation rate of 30 inches per year, approximately 1,062 acre-feet or 346 million gallons would fall directly onto the lake annually. Annual lake evaporation is estimated at 30 inches per year, which is approximately equal to precipitation. The estimated withdrawal of 6.9 million gallons from the Arnica Sink well(s) would be equivalent to about 1.9 percent of annual precipitation falling on the lake. If the same volume were withdrawn directly from the lake, with no recharge from springs and groundwater

Table 4.3-1: Estimated Water Usage During Construction Period

Activity	Volume Used			Estimated Maximum Flow Rate	
	Arnica Sink [1]	Calpine Well[1]	Total	Arnica Sink	Calpine Well
Construction of the power plant and the wells pads	2.2 mg [2]	4.3 mg	6.5 mg	10,000 g/d [2]	10,000 g/d
Drilling of production and injection wells	3.7 mg	7.5 mg	11.2 mg[3]	20,000 g/d	20,000 g/d
Dust suppression at power plant and wellfield	0.3 mg	0.1 mg	0.4 mg		
Dust suppression along transmission lines[4]		3.0 mg	3.0 mg		15,000 g/d
Cooling water required at power plant startup[5]		1.0 mg	1.0 mg		
Fire protection[6]		0.2 mg	0.2 mg		
Domestic uses, other than drinking water	0.7 mg	1.3 mg	2.0 mg	1,780 g/d	1,780 g/d
Total	6.9 mg	17.4 mg	24.3 mg		

1 The well at Arnica Sink would be used for the first year of construction. In the second and third year, water would be supplied by a well located on Calpine's Fourmile Hill leases.

2 mg = million gallons; g/d = gallons per day

3 This assumes that 11 production wells and 3 injections wells are drilled and that drilling each well would require 20,000 gallons of water per day for 40 days. These water quantities numbers are based on estimations that drilling these types of geothermal wells requires from 9,000 to 40,000 gallons per day, for 25 to 90 days (USFS et al. 1994). The higher water usage estimates would be to offset continued lost circulation, which is an unlikely occurrence with the proposed project.

4 This assumes 5,000 gallons of water would be used daily for dust suppression along each mile of dirt road. Approximately 3 miles of access roads would be used each day during the summer construction season which would last approximately 100 days. Because all roads would not be constructed in one season, it is assumed that half of the water would be used in the second year of construction and half during the third year of construction. Water may be drawn from wells near the access roads rather than entirely from the Calpine well.

5 Water requirements would be negligible after startup because sufficient steam condensate would be available to provide plant water needs and to offset losses due to evaporation and drift.

6 The initial water for the fire system would rarely need to be replaced.

SOURCE: Calpine 1995

seepage, the lake level would drop approximately 0.59 inches. Schneider and McFarland (1996) suggest that lake levels can vary naturally by several feet. The project would therefore not significantly affect lake levels. Withdrawal of 6.9 million gallons from Arnica Sink is not likely to have a measurable effect on Medicine Lake.

Withdrawal of water from Arnica Sink could reduce the recharge to other waterbodies in the project vicinity, such as Little Medicine Lake and Paynes Creek. The effects on recharge would be adverse, but not significant. Given the area of the Arnica Sink water basin, the high rate of annual precipitation, and the estimated fraction of groundwater recharge, withdrawal of 6.6 million gallons for project activities would be relatively small compared to the rate of annual recharge.

Project water withdrawals from Arnica Sink wells would not affect groundwater resources in the Mt. Dome/Klamath Lake, Tule Lake, or Butte Valley areas. Arnica Sink is located within the Medicine Lake caldera in the Central Valley drainage basin. The Mt. Dome/Klamath Lake, Tule Lake, and Butte Valley groundwater basins are all located within the North Coast drainage basin. As discussed in Section 3.3, Hydrology, groundwater drainage patterns in the area are believed to be approximately the same as surface water patterns. Therefore, it can be reasonably concluded that there is no hydrologic connection between the Arnica Sink and Mt. Dome, Tule Lake, or Butte Valley groundwater aquifers. For the Butte Valley basin, this conclusion is further supported by the fact that the Butte Valley groundwater aquifer has been found to be primarily located within local basalt flows which do not extend to the project area or Arnica Sink.

There is some uncertainty about the hydrogeologic connection between the Medicine Lake area and the Fall River springs approximately 30 miles to the south. However, groundwater in the Arnica Sink area is believed to be located in a perched water table with little, if any, connection to the regional groundwater system. If there is a hydrologic connection between Arnica Sink and the Fall River springs, withdrawal of approximately 6.9 million gallons from the Arnica Sink well(s) would be unlikely to have an adverse impact on the springs. Discharge from the Fall River springs is estimated at 1,200 cubic feet per second or 283 billion gallons per year. The estimated project water use of 6.9 million gallons from Arnica Sink would be less than 0.003 percent of the annual outflow from the Fall River springs. Use of this amount of water would not measurably affect water availability.

Effect of Water Withdrawals from Well(s) on Calpine's Lease Area: After the first drilling season, water would be supplied from a well drilled into the shallow aquifer on Calpine's Fourmile Hill leases, and supplemented as needed by water from the Arnica Sink well(s) or other sources (Calpine 1995). Maximum water use would occur during the third season of construction when 10 million gallons of water would be required.

Water withdrawals from the Calpine well, especially during peak pumping periods, could lower local groundwater levels. This effect would be temporary and not significant because the water levels would be expected to rebound after pumping is stopped. Groundwater pumping would not be expected to impact the unnamed lake located about 1.5 miles east of the proposed power plant location. This lake is located in a breached crater several hundred feet above the plant and wellfield area and is fed by springs from a perched water table. Therefore, pumping of shallow groundwater from Calpine's lease area should not affect this lake.

Maximum water use would occur during the third construction season and would not significantly affect groundwater resources in the Mt. Dome/Klamath Lake

groundwater basin. Proposed pumping would reduce the recharge to the Mt. Dome/Klamath Lake basin; however, the amount of water used by the project would be small in relation to total recharge to the basin. Using a 50% evaporation rate and 30 inches of precipitation annually, the recharge area required to supply 10 million gallons of water annually would be approximately 25 acres. This amount of water would be extracted from a groundwater basin that extends at least 20 miles to the north. Impacts to the Mt. Dome/Klamath Lake groundwater basin from withdrawal of this amount of water would be adverse, but not significant.

The project would use approximately 7.4 million gallons of water during the second construction season. For the same reasons discussed above, withdrawal of this amount of water from the well on Calpine's lease area would not affect groundwater resources in the Mt. Dome/Klamath Lake groundwater basin.

The water supply for Lava Beds National Monument comes from a well near the monument headquarters in the Tule Lake basin, about 6 miles northeast of Calpine's Fourmile Hill leases. The well is screened from 709 feet to 758 feet below the ground surface, in the shallow groundwater aquifer. Shallow groundwater from the eastern portion of Calpine's Fourmile Hill leases may partially contribute to recharge the well; however, a strong northwest-trending fault pattern that exists between the Mt. Dome and Tule Lake basins probably restricts groundwater flow between the two basins (see Figure 3.2-1). Primary recharge to the Tule Lake basin and yield of the Lava Beds well comes from the northeast portion of the Medicine Lake Highlands within the Tule Lake hydrologic subarea. Due to the relative size of the recharge area and limited groundwater connection to the project area, there would not be a significant effect on the Lava Beds water supply or Tule Lake groundwater basin as a result of water withdrawals from the project area during construction.

Proposed pumping of wells on Calpine's leases would not be expected to affect Butte Valley groundwater resources. Butte Valley and Calpine's lease area are both located within the North Coast drainage basin and could theoretically share a subsurface hydrologic connection. However, current understanding of the Butte Valley aquifer is that it is primarily found in local basalt flows that do not extend to the Fourmile Hill area. Therefore, it can be reasonably assumed that there is not a subsurface hydrologic connection between the project area and Butte Valley and that project water withdrawals would not affect groundwater resources in Butte Valley.

Medicine Lake, Little Medicine Lake, and Paynes Creek are located within the Medicine Lake caldera in the Central Valley drainage basin, while Calpine's lease area is in the North Coast drainage basin. Groundwater flow patterns are believed to be approximately the same as surface water patterns. Therefore, it can be reasonably assumed that there is no subsurface connection between the project area and waterbodies south of the drainage divide within the Medicine Lake caldera. Given this, estimated water withdrawals from a well located on Calpine's lease area would not affect Medicine Lake, Little Medicine Lake, or other nearby water resources. The Fall River springs are also located within the Central Valley drainage basin, 30 miles south of the lease area. For the same reasons described above, water withdrawals from the well located on Calpine's lease area would not be expected to affect the Fall River springs.

Operation: During the operation phase, a maximum water usage of approximately 1.45 million gallons per year would be required. This water would be used for domestic uses by employees at the site and drilling of infill production wells. Domestic use (other than drinking water) would require about 650,000 gallons of water per year (BLM and USFS 1984). The proposed project includes drilling of one infill production well every 2 years. Drilling of each infill well would require 800,000 gallons of water over a 40-day period (Calpine 1995). Water for the operation phase of the proposed action would be supplied from a well on Calpine's Fourmile Hill leases. Additional water would be required to replenish the cooling water during operation of the power plant; however, this cooling water would be supplied by geothermal steam condensate, and therefore would not impact the shallow groundwater supply.

Annual water use during the operation phase would be substantially less than during the construction phase and would be a tiny fraction of the annual precipitation falling directly on Calpine's Fourmile Hill leases that provides recharge to groundwater. For the reasons discussed above, effects of projected water usage on the supply of local or regional surface water or groundwater would be adverse, but not significant during this phase.

Decommissioning: Water use during decommissioning would be primarily for domestic purposes and dust control. Water for the decommissioning phase of the proposed project would be supplied from the well on Calpine's Fourmile Hill leases. Annual water use during this phase would be approximately 650,000 gallons, which would be substantially less than that used during the construction phase and would be a tiny fraction of the annual precipitation falling directly on Calpine's Fourmile Hill leases. For the reasons discussed above, water use during decommissioning would have an adverse, but not significant impact on local or regional surface water or groundwater supplies.

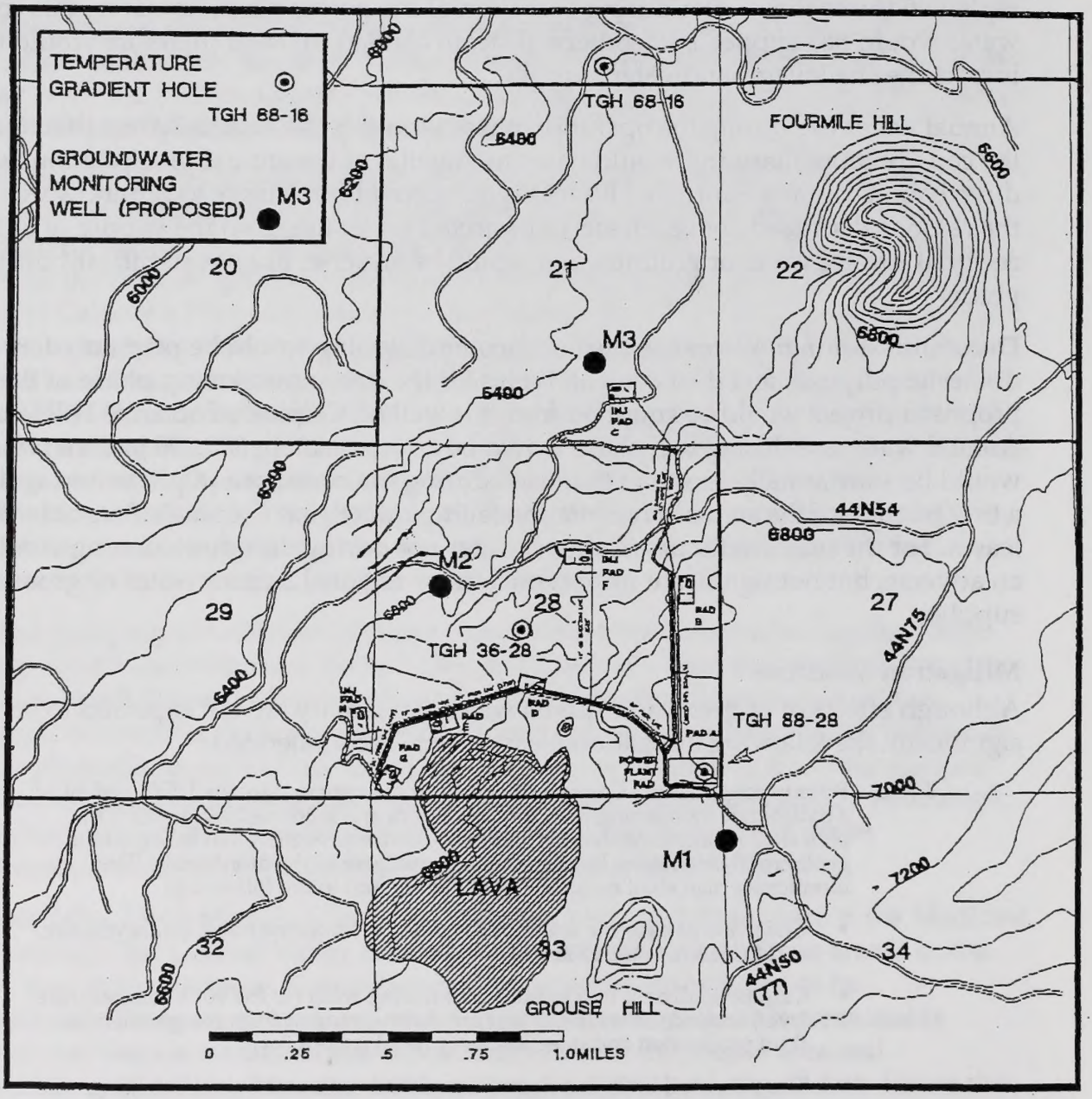
Mitigation Measures

Although effects of project water use on water availability are not expected to be significant, the following mitigation measures are recommended.

4.3.1a Prior to construction, Calpine shall submit for approval by the USFS and BLM a hydrologic monitoring plan for the caldera and a defined local area. This plan shall be implemented by Calpine, with the provision that other active geothermal developers be required to participate in the monitoring. The monitoring plan shall include, but not be limited to the following:

- Collection of baseline water quality data at Medicine Lake, Bullseye Lake, and Little Medicine Lake
- Calpine shall drill two to three monitoring wells (to the 90° F temperature level) around the wellfield that are down-gradient from the geothermal fluid production and injection wells (see Figure 4.3-1)
- The plan shall include a description of the wells and the well drilling procedures that will be used
- Monitoring shall include measurement of water levels in wells and analysis of standard drinking water quality constituents
- The plan shall include a description of the sampling and analysis schedule
- Record of groundwater pumping rates

Figure 4.3-1: Location of Groundwater Monitoring Wells



- If groundwater contamination is detected, procedure for identifying and repairing the well that caused the contamination

Groundwater pumping rates shall be reduced if monitoring detects significant adverse impacts to water availability, and these impacts can be attributed to project pumping of local groundwater. (C, O)

Level of Significance After Mitigation

Less than significant.

4.3.2 Effects of Geothermal Fluid Production and Injection on Water Quantity

Production and injection of geothermal fluids during construction and operation of the proposed project would not affect local or regional water supplies because recharge to the geothermal system is not believed to come from the shallow groundwater aquifer. No geothermal fluids would be produced or injected during decommissioning and there would be no effect during this phase.

Construction: During the construction phase of the proposed action, production wells would be drilled and tested. Minimal amounts of geothermal fluid would be removed from the geothermal reservoir. These fluid withdrawals would not affect the availability of local or regional groundwater supplies.

Operation: During the operation phase of the proposed project, approximately 2.9 million pounds per hour of geothermal fluids would be produced from production wells and approximately 2.4 million pounds per hour would be injected back into the geothermal reservoir (see Section 4.4, Geothermal Resources). Thus, there would be a net loss of fluids of approximately 475,000 pounds per hour from the geothermal reservoir. As described in Section 3.4, Geothermal Resources, it is believed that a layer of lithic tuff creates an impermeable barrier between the shallow, cold groundwater resource and the geothermal system. To the extent that recharge to the geothermal reservoir occurs, it is believed that water comes from depths considerably below the geothermal reservoir and is drawn upward by the geothermal heat source located within the Medicine Lake caldera ring-fracture system (Figure 3.4-2). Based on this model of the geothermal system, it can be concluded that recharge to the geothermal system as a result of the proposed net fluid withdrawal would not come from local or regional groundwater supplies and would not affect these resources.

Decommissioning: During project decommissioning, no geothermal fluids would be produced or injected and there would be no effect on local or regional groundwater supplies.

Mitigation Measures

Although effects of production and injection of geothermal fluids on groundwater availability are not expected to be significant, the hydrologic monitoring plan outlined in Mitigation Measures 4.3.1a combined with the following mitigation measure would ensure adequate protection of groundwater availability.

4.3.2a If hydrologic monitoring detects significant adverse impacts to water quantity from the production or injection of geothermal fluids, the USFS and BLM shall require Calpine to make appropriate changes to operational procedures that will increase groundwater availability. These changes could include changes in production and injection rates and locations. (O)

Level of Significance After Mitigation
Less than significant.

4.3.3 Effects of Increased Surface Runoff

Construction activities associated with the proposed project could lead to increased rates and/or quantities of surface runoff and associated erosion. Due to the high permeability of area soils and planned management practices, any increases in surface runoff and associated effects would be adverse, but not significant. The operation phase of the proposed action would not affect surface runoff. During the decommissioning phase, the project area would be restored as much as possible to pre-project conditions. These activities would reduce surface runoff and thus would have a beneficial impact.

Construction: During the construction phase of the proposed action, changes would be made to the ground surface which would decrease percolation of stormwater and hence increase surface water runoff. The topographic changes would include removal of vegetation and soils, compaction of earth materials, paving, building construction, and alterations to surface water drainages. Disturbance of intermittent stream channels would be minimized and would be limited to the power plant, well pads, and new access roads. Table 4.3-2 summarizes the area that would be subject to altered surface water runoff and infiltration.

Table 4.3-2: Areas Subject to Surface Water Runoff Mitigation

Type of Surface Disturbance	Area of Disturbance (acres)
Vegetation removed and surface compacted or paved (power plant, well pads, pipeline pathways, transmission line structures, substation, new bladed roads, existing roads to be improved)	177.3
Vegetation removed and reseeded (Transmission line right-of-way)	136 [1]
Disturbed by partial vegetation removal or surface compaction (new non-bladed roads)	75.2

[1] See Table 2.2-1 for more detailed description of surface disturbance.

Grading for construction of the power plant, wells pads, transmission line structures, and roads has the potential to increase erosion of existing channels, create new channels, decrease the amount of water infiltration, and increase the amount of surface water runoff. Activities associated with the proposed project would comply with applicable guidelines and best management practices to minimize impacts. At the power plant and well pads, berms and culverts would control runoff and minimize the accidental creation of new drainage channels. Changes to existing drainage channels would be minimized. In addition to planned management activities, increases in the rate and/or quantity of surface runoff at the power plant site and wellfield would be

minimized by the rapid infiltration rates of most soils in this area. Surface runoff only occurs when rainfall or snowmelt rates are very high. For these reasons, increased surface runoff as a result of the proposed action would not be significant in this area.

Construction of the transmission line would impact surface runoff through clearing along the right-of-way and construction of new unpaved access roads. Vegetation would be selectively removed along the transmission line corridor and sites cleared for construction of transmission line structures. Grading might be required at some transmission line structure sites. The removal of vegetation and localized compaction of soils would lead to increased runoff and could potentially result in localized erosion.

Construction of new access roads would result in compaction of native soils or imported earth material, with an associated decrease in soil permeability. This would result in an increased runoff potential in most locations. Where roads are built across bedrock, runoff potential probably would not be significantly affected, as these areas already have rapid runoff potentials. Increased runoff from road construction could result in localized erosion.

Although construction of the transmission line could result in increased runoff rates, most soils along the proposed transmission line route and access roads are characterized by rapid infiltration rates. These soils would be sufficiently permeable so that any excess runoff would percolate into the subsurface a short distance downstream from the transmission line corridor or access roads. Therefore, construction of the transmission line would not significantly increase surface runoff.

Operation: During the operation phase of the proposed project, there would be no additional disturbance to vegetation or soils. Increased surface runoff created by vegetation removal during the construction phase would continue during the operation phase. For the reasons described above, the increase in surface runoff would be adverse, but not significant.

Decommissioning: As part of decommissioning the project area would be generally returned to pre-project conditions. Decommissioning would involve the dismantling of all project facilities, including the power plant, pipelines, well pad equipment, and transmission line. Areas disturbed and graded by the project would be reseeded and recontoured to essentially pre-project topography, where necessary and as directed by USFS. These activities would reduce any project impact on surface runoff rates. The decommissioning phase of the proposed action would reduce surface runoff and therefore have a beneficial effect.

Mitigation Measures

Although the effects of increased surface runoff would not be significant, the following mitigation measures would help control runoff. Mitigation measures to reduce soil erosion would also help reduce surface runoff. These measures are detailed in Section 4.2, Geology and Soils.

4.3.3a Calpine shall reseed, as recommended by USFS, all disturbed areas that will not be used (such as cut and fill slopes) after completion of the construction phase. (C)

4.3.3b Calpine shall temporarily store excess runoff in well pad sumps or inject it into the geothermal system via injection wells. (C)

4.3.3c Calpine shall place drains or energy dissipaters at intervals along new access roads to allow water greater opportunities to exit the roadbed and percolate into the native soils, and prevent the discharge of large volumes of runoff at a few points along the road. (C)

4.3.3d Calpine shall monitor new non-bladed roads for impacts to vegetation and increased runoff and erosion. If substantial impacts occur, Calpine shall implement corrective actions. These measures could include construction of energy dissipaters, berms or culverts, or other appropriate runoff diversion structures. (C)

4.3.3e Calpine shall seed and plant as recommended by USFS the area of the transmission line right-of-way disturbed during construction with low-growing native plants to provide soil stabilization. Seeding and planting shall occur before the next growing season after construction. Native plants that naturally revegetate (such as resprouting shrubs) should be utilized to the fullest extent possible. This mitigation measure shall be consistent with Mitigation Measure 4.7.1d.(C)

Level of Significance After Mitigation

Less than significant.

4.3.4 Effects of Flooding

Construction of the proposed project could result in minor changes in surface drainage patterns. Due to the planned control measures and the high permeability of area soils, localized flooding would not occur. No project facilities or activities would be located within a 100-year flood plain, and there would be no effect from flooding on people or property as a result of the proposed project.

Construction: Surface disturbance caused by proposed construction activities, such as grading, could lead to minor changes in surface drainage patterns. Construction of project facilities and access roads would include the use of culverts and berms to direct drainage and avoid localized flooding. These measures combined with the high permeability of project area soils would ensure that no localized flooding would occur. No construction activities for the proposed project would take place within a 100-year flood plain, and there would be no impact on people or property from flooding as a result of the proposed project.

Operation: During the operation phase, project activities would not affect drainage or flooding patterns. Minor changes in surface drainage patterns created during the construction phase would continue through the operational phase. As described above, these changes would not result in localized flooding. No project activities or facilities would be located within a 100-year flood plain, and there would be no impact on people or property from flooding as a result of the proposed project during this phase.

Decommissioning: During decommissioning, the project area would be returned, as much as possible, to pre-project conditions. These activities would return some surface drainages to their original state and would not result in any localized flooding. During this phase, no project activities would be located within a 100-year flood plain, and there would be no impact on people or property from flooding as a result of the proposed project .

Mitigation Measures

The proposed project would not have a significant effect on flooding and no mitigation measures are recommended.

4.3.5 Effects on Stream Channels

Construction, operation, and decommissioning of the proposed project could cause increased scour and erosion within stream channels crossed by the transmission line. In addition, siting of project facilities within Riparian Reserves would conflict with management standards for these areas which would be a significant impact.

Construction: Construction of the power plant and wellfield would not affect any perennial or intermittent streams. Construction of the transmission line would not affect any perennial or intermittent streams marked on USGS maps. However, this transmission line may cross small, intermittent creeks that are not large enough to be included on USGS maps. Construction of the proposed project could cause increased scour and erosion within stream or creek channels if transmission line structures or access roads are constructed within streambeds. In addition, transmission line structures and access roads could be damaged by erosion if these facilities are constructed within streambeds. Construction activities which require vehicles to cross streambeds would also cause erosion within the streambed and on the bank. Construction of the proposed project could conflict with management policies for Riparian Reserves if project facilities or activities are located within Riparian Reserves (see Section 3.10, Plans and Policies for details of these policies). The power plant and wellfield would not be located within a Riparian Reserve. Segment A1 of the transmission line would traverse a wet meadow that is a Riparian Reserve.

It would be inconsistent with the policies of the Klamath and Modoc National Forest LRMPs if proposed transmission line structures and access roads, other than for stream crossings, are sited within Riparian Reserves. Due to the potential impact on the aquatic environment, this inconsistency would be considered a significant impact.

Operation: During the operation phase of the project, maintenance along the transmission line may require vehicles to cross intermittent stream channels. Vehicle traffic could result in temporarily increased erosion within the channel and along the bank. As described above, siting of transmission line structures or access roads (other than for stream crossings) within Riparian Reserves would be a significant impact.

Decommissioning: During decommissioning of the project, removal of the transmission line and associated structures may require vehicles to cross intermittent stream channels. Vehicle traffic could result in increased erosion within the channel and along the bank. These effects would be adverse, but not significant. During decommissioning, project facilities located within Riparian Reserves would be removed which would eliminate the inconsistency with the Klamath and Modoc National Forest LRMPs.

Mitigation Measures

The following mitigation measures are recommended to reduce the effects of the proposed project to a less than significant level.

4.3.5a Calpine shall not site transmission line structures and access roads within Riparian Reserves, as delineated by the USFS. For streams located outside of Riparian Reserve areas, Calpine shall not site transmission line structures and access roads (except road crossings) within 100 feet of intermittent stream channels. (C)

4.3.5b Calpine shall ensure that vehicular traffic in intermittent stream channels is minimized. (C, O, D)

Level of Significance After Mitigation

Less than significant.

4.3.6 Effects of Geothermal Drilling, Production, and Injection on Water Quality

The proposed drilling, production, and injection activities during the construction and operation phases of the proposed project are not expected to have an adverse effect on water quality. Effects could potentially occur to water quality through accidental introduction of geothermal fluids into the shallow groundwater aquifer during drilling or operations or through accidental discharge of geothermal fluids to surface drainages. Planned control measures are designed to ensure that the effects of drilling, production, and injection would not have a significant effect on surface water or groundwater. The decommissioning phase of the project would not affect water quality.

Construction: Activities associated with the proposed action would comply with applicable guidelines and best management practices to minimize impacts from drilling of wells. Planned measures which would reduce impacts include:

- Proper well construction techniques
- Use of lost circulation reduction material
- Use of blowout preventers on well heads during drilling
- Use of berms around drill pads to control runoff
- Proper construction and maintenance of sumps with an impermeable liner to prevent leakage of fluids
- Maintenance of adequate freeboard in sumps to prevent overflow of fluids

These management practices would ensure that impacts to groundwater and surface water quality from drilling activities would not be significant.

Potential accidental impacts to the shallow groundwater aquifer from drilling of the geothermal wells include loss of drilling mud into formation, mixing of geothermal fluids with shallow groundwater before casing can be installed, accidental spillage of drilling mud or geothermal fluids into intermittent surface water drainages, and leakage of drilling mud from well pad sumps into the shallow groundwater. However, under normal operations these impacts are not expected to occur due to drilling and testing procedures designed to ensure the operational integrity of the wells and casing.

The drilling process requires the use of drilling fluids to lubricate the drill bit, stabilize the hole, and remove drill cuttings. In certain circumstances where rocks are permeable, drilling fluids may be lost to the rock formation during the drilling process. Excessive loss of fluids can result in localized changes to groundwater quality. These effects would be adverse, but not significant because drilling fluids are composed of non-toxic

constituents that would cause minimal water quality degradation. In addition, proposed drilling practices would use materials to reduce lost circulation.

For the proposed action, the drilling mud would be treated and contained in a "closed" system (within metal tanks) for continuous circulation during drilling. This "sumpless" system would reduce the risk of spillage of drilling fluids to the surface or infiltration of drilling fluids into the shallow groundwater via seepage from drilling sumps or surface spills.

Liquid wastes produced during well drilling consist of water, non-toxic drilling additives, rock cuttings, and geothermal fluid. Once drilling is completed, the washed and separated solids would be disposed of into the solids disposal sump and each well pad. The liquid fraction would be directed to a lined sump with an impermeable clay or artificial liner, and would be constructed to have a permeability of no more than 10^{-6} centimeters per second, in accordance with GRO Order No. 4 and the North Coast RWQCB requirements. Each liquid-holding sump would have a capacity of 750,000 gallons.

If accumulated fluids in a sump approach capacity (less than 3 feet of freeboard), then fluid would be routed to another sump, or drilling (or testing or start-up activities) would be suspended until such time as adequate sump or injection capacity becomes available. Geothermal fluids produced during well testing, maintenance, and start-up would also be routed to these liquid-holding sumps, and disposed of by injection into the geothermal reservoir.

Operation: During the operation phase of the project, impacts to water quality could occur as a result of mixing of the geothermal fluid in the shallow groundwater aquifer through damaged well casings or accidental discharge of geothermal fluids to the surface. Based upon available data from previous exploration activities, there appears to be no direct connection between the shallow groundwater and the geothermal system (see Section 4.4, Geothermal Resources for a more detailed discussion of this separation). Proper construction of the production and injection wells, by cementing and sealing of the shallow groundwater aquifer behind casing, would prevent geothermal fluids from mixing with shallow groundwater. However, effects to local groundwater quality could occur if the well casings were to fail, particularly those in the injection wells. These effects would not be expected to be significant due to the low probability of a well casing failure and the localized nature of potential effects.

No discharge of geothermal fluids to surface drainages is planned. Accidental discharge of geothermal liquids to surface drainages is possible due to blowouts during drilling, leaking wellheads or piping, and overflow and leakage of well pad sumps. The nearest perennial water body downstream from the power plant and wellfield area is Lower Klamath Lake Sump, located about 16 miles north. Because of the moderate to very rapid infiltration rate of the soils in the wellfield and power plant area, it is extremely unlikely that geothermal fluids would be generated in sufficient quantities to flow 16 miles to the Lower Klamath Lake Sump. Accidental discharges would percolate into the subsurface, but because of the depth to the shallow groundwater they would probably be absorbed by soils and bedrock prior to mixing with groundwater. Therefore,

accidental discharge of geothermal fluids would not be expected to significantly affect surface water or groundwater quality.

Effects on Regional Water Resources: The Lava Beds National Monument water supply would not be affected by accidental discharge of geothermal fluids to surface waters. Intermittent surface water drainage from the Calpine lease area does not come closer than 3 miles from the Lava Beds well.

The Pit River, Fall River, and Ajumawi Lava Springs State Park are located over 30 miles south of the power plant site and wellfield. They are all located in a different surface water drainage basin and in a different groundwater basin (Figure 3.3-4) (RWQCB 1994a; USFS 1991b). Therefore, accidental discharge of geothermal fluids on Calpine's Fourmile Hill leases would not impact surface water or groundwater in these areas.

Decommissioning: During decommissioning of the proposed action the wells would be capped and no drilling, production, or injection activities would occur. In addition, no other activities that could potentially degrade water quality would occur. Thus, the decommissioning phase would not affect surface water or groundwater quality.

Mitigation Measures

Although the drilling, production, and injection activities of the proposed action would not have a significant effect on water quality, Mitigation Measure 4.3.2a would minimize impacts to water quality. The following mitigation measure are recommended to further minimize impacts.

4.3.6a If a high volume of drilling muds are lost to the formation, the drilling contractor shall use Lost Circulation Material (LCM) to seal the well and reduce the migration of drilling mud into the formation. LCM can include constituents such as cottonseed hulls, wood chips, sawdust , etc. Alternatively, the contractor shall use air, foam or aerated mud instead of LCM to reduce the lost circulation. This technique would reduce lost circulation by reducing pressure in the hole. (C)

4.3.6b The BLM shall require Calpine to periodically test the mechanical integrity of the wells to reduce the potential for failure of the well casings. Tests results shall be submitted to the BLM. (O)

4.3.6c The Calpine Emergency Contingency Plan shall define control and restoration measures to be implemented in the event of a sump overflow, pipeline rupture, or well blowout. (C, O)

Level of Significance After Mitigation

Less than significant.

4.3.7 Effects of Air Emissions on Water Quality

The proposed project would result in air emissions that could result in geothermal steam or condensate constituents being deposited on nearby waterbodies. However, the distance to the nearest downwind waterbodies would ensure that contaminants are diluted below concentrations that would significantly impact water quality.

Construction: During the construction phase of the proposed project, fugitive dust would be generated by drilling and construction activities. The dust would migrate downwind to the northeast, according to the prevailing southwest wind direction

(USFS 1994b; USFS 1991b). The perennial waterbodies nearest to the northeast of the proposed plant site and wellfield are several streams located about 15 miles away, and Clear Lake Reservoir located about 20 miles away. Fugitive dust would be expected to settle out of the atmosphere before reaching any of these waterbodies. Therefore, effects of deposition from power plant and wellfield construction dust on water quality would be adverse, but not significant during the construction phase.

The proposed transmission line corridor would be located within a few miles of several intermittent streams. The proposed transmission line does not cross any intermittent streams; however, the line may cross small streams that are not marked on USGS maps. At its eastern terminus, the transmission line would be within 3 miles of Clear Lake Reservoir. Fugitive dust generated by construction of the transmission line would be expected to settle out of the air before reaching Clear Lake Reservoir or any of the nearby streams. Some project-generated dust would settle within the beds of the three intermittent streams crossed by the transmission lines. If the streams are running during the construction period, the fugitive dust would have a temporary, adverse impact on the water quality of these intermittent streams. This impact would be temporary and would not affect any potential water uses. Therefore, the impact of fugitive dust generated by construction of the transmission line would be less than significant.

Steam and water droplets emitted during well testing would likely fall out largely on the well pad. Well testing emissions would be short-term and unlikely to cause water quality effects due to the distance to surface water.

Operation: During the operational phase of the proposed project, air emissions would be released from the cooling tower and plant silencers (see Section 4.13, Air Quality for more information). These emissions would be composed of gases, including water vapor and noncondensable gases, and droplets of water. The water droplets would contain dissolved and suspended solids, including trace amounts of heavy metals, such as mercury and arsenic. The largest droplets would fall to the ground in the vicinity of the power plant and cooling tower. The smallest droplets may evaporate with the suspended and dissolved solids they contain forming aerosol particles which would be dispersed over a wide area.

Deposition of metals and hydrogen sulfide into lakes in the project vicinity could adversely affect the water quality of these lakes. The impact on nearby lakes would be a function of their distance from the power plant, the composition of the transported material, and the frequency of the wind blowing in the direction of the lakes. The nearest lake to the proposed power plant site is the unnamed lake located approximately 1.5 miles due east of the plant site. Although this lake is located nearest to the plant, effects would be minimal because the wind only blows in that direction approximately three percent of the time. The next nearest lakes to the power plant site would be Medicine Lake and Little Medicine Lake. These lakes are located approximately three miles south-southeast of the power plant site. The wind blows in the direction of Medicine Lake approximately 11.2 percent of the time (Suder 1997, personal communication).

In order to assess the potential impacts from project air emissions to the water quality of Medicine Lake, the concentrations of selected elements and compounds in the lake were estimated using a set of assumptions that represent a worst-case scenario .

It is difficult to accurately estimate deposition of project-generated air emissions onto the lake because of the number of variables involved. Instead of attempting to create a complex, but realistic model of deposition on Medicine Lake, a simplified and unrealistically conservative model (i.e., a worst-case scenario) was used to assess project impacts on the lake. This model showed that even using very conservative assumptions (including some that physically could not occur), there would not be a significant effect on Medicine Lake water quality. The deposition analysis made the following assumptions:

- All of the plant emissions blowing towards Medicine Lake (11.2 percent of total emissions) were assumed to be deposited in the lake, either directly or through runoff. Table 4.3-3 lists the mass of air constituents blowing towards Medicine Lake annually as determined by the air quality analysis.
- The total volume of Medicine Lake = 23.78×10^9 L[1].
- Each potential pollutant mass was summed over a 45-year project life with no consideration of dilution due to lake recharge by springs or precipitation.
- All metals were considered to be either solubilized or contained in suspension.
- The total modeled H_2S blowing towards Medicine Lake was assumed to be converted to sulfuric acid (H_2SO_4) in the air by oxidation to sulfur dioxide and sulfur trioxide. For this analysis, the total mass of H_2S was used to estimate SO_4 loading in the lake .

The simplistic assumptions in this deposition analysis are extremely conservative, and actual changes in water quality would be substantially lower than estimated by this model. The analysis is conservative for the following reasons:

- Not all of the emission blowing towards Medicine Lake would be deposited in the lake. Many of the pollutants emitted would be deposited before reaching Medicine Lake and its watershed.
- Average rainfall in the project area is 30 inches per year. Assuming a 50 percent evaporation rate and 425-acre lake surface, recharge to the lake from direct rainfall would be approximately 530 acre-feet per year. This recharge would substantially dilute deposited pollutants.

The results of the deposition analysis indicate that concentrations of arsenic, antimony, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel and selenium in the lake, after 45 years of accumulation, were all significantly below regulatory limits for drinking water (Table 4.3-3). EPA-established Maximum Contaminant Levels (MCLs) were used as the primary regulatory level. Where no MCL existed, the Suggested No-Adverse-Response Levels (SNARLs) established by the National Academy of Sciences for drinking water were used.

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[1] Lake surface area = 18×10^6 ft^2 (425 acres); maximum lake depth = 140 feet. The volume of the lake was calculated by assuming the lake is the shape of an inverted cone with depth 140 feet and base surface area equal to the surface area of the lake. Using the formula for the volume of a cone, the lake volume = 840×10^6 ft^3 = 6.282×10^9 gallons. This estimate is somewhat smaller than the actual volume of Medicine Lake because the lake is more bowl-shaped than cone-shaped. For this analysis, a lake of smaller volume would tend to overestimate the effects of air emissions deposited in the lake.

Table 4.3-3: Deposition of Air Emission on Medicine Lake

Constituent	Project Air Emissions Blowing Toward Medicine Lake (lbs/year) [a]	Estimated Concentration in Lake After 45 Years (mg/l) [b]	MCL/SNARL (mg/l) [c]
Antimony	1.0×10^{-2}	8.7×10^{-6}	3.0×10^{-3}
Arsenic	3.0×10^{-1}	2.6×10^{-4}	5.0×10^{-2}
Beryllium	1.1×10^{-4}	9.5×10^{-8}	none
Boron	1.0	8.7×10^{-4}	6.0×10^{-1}
Cadmium	1.1×10^{-4}	9.5×10^{-8}	1.0×10^{-2}
Chromium	1.1×10^{-4}	9.5×10^{-8}	5.0×10^{-2}
Cobalt	1.1×10^{-4}	9.5×10^{-8}	none
Copper	1.4×10^{-4}	1.2×10^{-7}	1.3
Lead	1.1×10^{-3}	9.5×10^{-7}	5.0×10^{-2}
Manganese	4.4×10^{-4}	3.8×10^{-7}	5.0×10^{-2}
Mercury	1.2×10^{-1}	1.0×10^{-4}	2.0×10^{-3}
Nickel	4.4×10^{-4}	3.8×10^{-7}	1.5×10^{-1}
Selenium	1.1×10^{-4}	9.5×10^{-8}	1.0×10^{-2}
Hydrogen Sulfide[d]	1622	-----	-----
Sulfate	4675	4.1	250

Notes:

[a] Projected emissions from project construction (well venting and flow testing during confirmation drilling) and 45 years of project operation (sources include cooling towers, vent silencer, and annual well testing), divided by 45 years.

[b] Estimated concentration of constituent in lake after 45 years of emissions with no dilution or dispersion and given the additional assumptions outlined in the text.

[c] Values for antimony and boron are SNARLs, other values are MCLs. See below for definition of MCLs and SNARLs.

[d] All hydrogen sulfide blowing towards Medicine Lake was assumed to be converted to sulfate.

SOURCE: Suder 1998 (second column); EGS 1998 (third column); EPA (last column)

None of the constituents would exceed either regulatory limit after 45 years of deposition. Arsenic concentrations after 45 years, based on these assumptions, are estimated to be 2.6×10^{-4} mg/L; the arsenic MCL is 5.00×10^{-2} mg/L. Estimates of sulfate loading indicate that SO_4 concentrations would increase to 4.1 mg/L after 45 years, using the above, highly conservative assumptions. No primary MCL for sulfate has been established but the secondary MCL is 250 mg/L. Thus, even with the extremely conservative assumptions of the deposition analysis, final concentrations of pollutants would not exceed any existing water quality regulatory levels. As shown in Table 4.3-4, none of the EPA criteria for the protection of wildlife would be exceeded.

The depositional analysis does not account for existing concentrations of the constituents in Medicine Lake. Analysis of water samples collected in Medicine Lake by Calpine in November, 1997, indicates that all constituents are below detectable limits (the only constituent with a relatively high detection limit was sodium, at 1.0 mg/L; all other constituents had very low detection limits). Thus, the background water-quality of Medicine Lake would not measurably change the values shown in Table 4.3-3.

Decommissioning: Fugitive dust may be emitted during the decommissioning activities. For the same reason discussed under the construction phase, this would not have a significant impact on water quality. No other effects to water quality would occur during decommissioning.

Mitigation Measures

Mitigation measures for controlling air emissions are described in Section 4.13, Air Quality.

Level of Significance After Mitigation

Less than significant.

4.3.8 Effects of Sanitary Waste on Water Quality

Sanitary wastes generated by project personnel would be disposed of at an appropriate off-site location and gray water would be injected into the geothermal reservoir. There would be no effects to surface water or groundwater quality from sanitary wastes during any of the three project phases.

Construction: During the construction phase of the proposed action, portable toilets would be installed near where crews are working. Sanitary wastes from the toilets would be pumped by a licensed commercial septic tank pumping service and disposed of at an appropriate off-site location. There would be no effects to local or regional water quality from sanitary wastes during this phase of the project.

Operation: During the operation phase, sanitary wastes would be treated by an engineered sewage treatment system. The system would have sufficient capacity to accommodate the normal on-site staff as well as occasional peaks in usage, for instance if a tour group is visiting the facility. Gray water from the treatment system would be injected into the geothermal reservoir. Injection of liquid sanitary wastes would not degrade groundwater quality because the geothermal reservoir is isolated from the shallow groundwater aquifer. Sludge from the sewage treatment system would be removed about once each year by a licensed commercial septic tank pumping service for appropriate disposal off-site. There would be no effects to water quality from sanitary wastes during the operation phase.

Decommissioning: During decommissioning, portable toilets would be used. As described under the construction phase, sanitary wastes would be disposed of off-site and there would be no effects to water quality.

Table 4.3-4: EPA Water Quality Criteria for the Protection of Aquatic Life[1]

Compound	EPA Water Quality Criteria		Pre-Project Water Quality[2]			Post-Project Water Quality[3]
	CMC[4]	CCC[4]	Medicine Lake	Little Medicine Lake	Bullseye Lake	Medicine Lake
Arsenic	0.34	0.15	< 0.005	< 0.005	< 0.005	0.00026
Boron	—	0.75[5]	< 0.10	< 0.10	< 0.10	0.00087
Mercury	0.0014	0.00077	< 0.0002	< 0.0002	< 0.0002	0.0001
Ammonia	0.58-33[6]	0.11-2.5[6]	0.13	< 0.050	< 0.050	—

Notes:

1 All values are in mg/l, which is equivalent to ppm

2 Source: Calpine surface water quality monitoring program; Data collected in November, 1997; values at Medicine Lake are averages of three samples taken at a depth of one foot. See response to "Comment—Hydrologic Monitoring Plan" in the Hydrology Section for the methodology

3 Estimated values taken from Fourmile Hill EIS/EIR Table 4.3-3. See Section 4.3.7 in the EIS/EIR for an explanation of the derivation of these values.

4 Sources: EPA 1986, 1992, and 1997. EPA set two criteria for each contaminant: (1) CMC = criteria maximum concentration; CMC is a one hour average, not to be exceeded more than once in three years, and (2) CCC = criteria chronic concentration; CCC is a four day average concentration, not to be exceeded more than once in three years.

5 A limit set mainly to protect crops

6 Ammonia toxicity is dependent on temperature and pH; a range of toxicity values is given; the lower bound is at pH = 9 and 86°F; the upper bound is at pH = 6.5 and 32°F. The pH and temperature for Medicine Lake at the surface = 45°F and pH = 6.9; Little Medicine Lake pH = 6.8; Bullseye Lake pH = 6.9; temperature was not measured at Little Medicine Lake or at Bullseye Lake.

Mitigation Measures

No mitigation measures would be required for effects of sanitary waste on water quality. All waste disposal would be in accordance with county and RWQCB requirements.

4.3.9 Effects of Chemical and Hazardous Material Spills on Water Quality

The proposed project would involve the use of several chemical and hazardous materials. During construction, operation, and decommissioning, accidental spills of these materials would not be expected to result in adverse impacts to water quality in the project vicinity, due to planned control practices.

Construction: During the construction phase of the proposed action, various potentially hazardous materials would be used. These materials include diesel fuel, lubricating fluids, anti-scaling and anti-corrosion chemicals, and chemicals to control

All tanks containing potentially hazardous liquid materials would be constructed above ground and would include secondary containment, such as a curbed or bermed area draining to a sump equipped with a low point valve that normally would be closed. The secondary containment would have a capacity equaling 100 to 150 percent of the total tank capacity. Spilled material would be confined within the secondary containment for collection and disposal to an appropriate facility. Precipitation falling and collecting in the secondary containment, if uncontaminated, would be directed to one of the well pad sumps for eventual injection into the geothermal reservoir. An Emergency Contingency Plan would be prepared for use in case of accidental spills or discharges.

As a result of planned control practices, spills of chemical and hazardous materials are not expected to affect surface water or groundwater quality.

Operation: During the operation phase, chemical and hazardous materials used and control measures implemented would be the same as those described for the construction phase. As discussed above, spills of chemical and hazardous materials are not expected to affect surface water or groundwater quality.

Decommissioning: During decommissioning, chemical and hazardous materials used and control measures implemented would be the same as those described for the construction phase. As discussed above, spills of chemical and hazardous materials are not expected to affect surface water or groundwater quality.

Mitigation Measures

No mitigation measures would be required for effects of chemical or hazardous material spills on water quality, as no effect is expected.

ALTERNATIVES

The following describes potential effects and recommended mitigation measures for each alternative to the proposed action. For Alternatives 2 through 6, potential impacts associated with the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of potential impacts along these portions of the transmission line are not repeated under each alternative discussion. The analysis of these impacts focuses on the effects that would be different from those identified for the proposed action.

Alternative 2 (Segments A1, A2, B1, C2)

Alternative 2 is the same as the proposed action except that segment C2 would replace segment C1, and there would be a correspondingly different location of the substation at the end of the transmission line. The effects of Alternative 2 on hydrology would be generally the same as for the proposed action, and not significant.

Segment C2 of the transmission line passes through a seasonal wetland area north of Dry Lakes. Construction of the transmission line through this area could disturb vegetation and surface soils; however, this would not lead to a significant increase in erosion since water flow rates in the area are extremely slow. In addition, no discharges

would be associated with construction, operation, or decommissioning of the transmission line. Therefore, construction of segment C2 through the Dry Lakes area would not significantly impact the quantity or quality of water in the seasonal wetland.

Segment C2 would also cross an intermittent stream located east of Highway 139. For the same reasons discussed under the proposed action, construction of the transmission line across this stream would be an adverse, but not significant impact.

The mitigation measures identified for the proposed project would apply to Alternative 2 as well. The impacts of Alternative 2 would be less than significant after mitigation.

Alternative 3 (Segments A1, B2, and C1)

Alternative 3 differs from the proposed action by the substitution of transmission line segment B2 for segments A2 and B1. The effects of Alternative 3 on hydrology would be generally the same as for the proposed project, and not significant.

The mitigation measures identified for the proposed project would apply to Alternative 3 as well. The impacts of Alternative 3 would be less than significant after mitigation.

Alternative 4 (Segments A1, B2, and C2)

Under Alternative 4 segment B2 would replace segments A2 and B1, and segment C2 would replace segment C1. The effect of Alternative 4 on hydrology, and the level of significance of the impacts would be generally the same as for the proposed project.

Segment C2 of the transmission line passes through a seasonal wetland area north of Dry Lakes. Construction of the transmission line through this area could disturb vegetation and surface soils; however, this would not lead to a significant increase in erosion since water flow rates in the area are extremely slow. In addition, no discharges would be associated with construction, operation, or decommissioning of the transmission line. Therefore, construction of segment C2 through the Dry Lakes area would not significantly impact the quantity or quality of water in the seasonal wetland.

Under Alternative 4, the transmission line would cross one intermittent streams along segment C2. For the reasons discussed under the proposed action, construction of the transmission line would have an adverse, but not significant impact on this stream.

The mitigation measures identified for the proposed project would apply to Alternative 4 as well. The impacts of Alternative 4 would be less than significant after mitigation.

Alternative 5 (Segments A3, B1, and C1)

Alternative 5 differs from the proposed action by the substitution of transmission line segment A3 for segments A1 and A2. The effects of Alternative 5 on hydrology, and the level of significance would be generally the same as for the proposed project.

With Alternative 5, the alternate transmission line route would cross up to two intermittent streams located along segment A3. Segment A3 would cross an intermittent stream that is parallel to Forest Road 49 and may cross a stream southwest of Aspen Crater. Neither of these streams is within a Riparian Reserve. For the reasons discussed under the proposed action, construction of the transmission line would have an adverse, but not significant effect on these streams.

The mitigation measures identified for the proposed project would apply to Alternative 5 as well. The impacts of Alternative 5 would be less than significant after mitigation.

Alternative 6 (Segments A3, B1, and C2)

Alternative 6 is similar to Alternative 5 except that it follows segment C2 north to avoid Tionesta, rather than following segment C1. Similar to Alternative 5, the effects of Alternative 6 on hydrology, and the level of significance would be generally the same as for the proposed project.

Segment C2 of the transmission line passes through a seasonal wetland area north of Dry Lakes. Construction of the transmission line through this area could disturb vegetation and surface soils; however, this would not lead to a significant increase in erosion since water flow rates in the area are extremely slow. In addition, no discharges would be associated with construction, operation, or decommissioning of the transmission line. Therefore, construction of segment C2 through the Dry Lakes area would not significantly impact the quantity or quality of water in the seasonal wetland.

Under this alternative, the transmission line route would cross three intermittent streams —two along segment A3 and one along segment C2. For the reasons discussed under the proposed action, construction of the transmission line would have an adverse, but not significant effect on these streams.

The mitigation measures identified for the proposed project would apply to Alternative 6 as well. The impacts of Alternative 6 would be less than significant after mitigation.

Alternative 7

There would be impact to hydrology under Alternative 7, the No Action alternative. No mitigation measures would apply to this alternative.

4.4 Geothermal Resources

KEY ISSUES

The key geothermal resources issues identified and evaluated in this section relate to the effects of the project on regional thermal features. This effect is evaluated in Impact 4.4.3.

SIGNIFICANCE CRITERIA

The effects of the proposed action would have a significant effect on geothermal resources if it were to substantially deplete the geothermal reservoir.

METHODOLOGY

To analyze the impacts of the proposed project on geothermal resources, the amount of geothermal fluids that would be withdrawn from and injected into the geothermal reservoir in the vicinity of Fourmile Hill was first calculated. These values were compared with estimates of total reservoir capacity to evaluate changes in reservoir life expectancy and reservoir characteristics that would occur as a result of the project. In addition, knowledge of other geothermal systems was applied to make reasonable assumptions about impacts on both the local and regional geothermal reservoir.

PROPOSED ACTION (ALTERNATIVE 1)

The impacts of development and production of the geothermal resources at Fourmile Hill are not fully understood because geothermal resource data are limited to exploration wells drilled by other geothermal developers and only limited well testing has occurred. However, scientific investigations and production at a number of geothermal fields over the past few years have given considerable knowledge of how geothermal reservoirs behave during development. Impacts considered in this analysis include:

- Effects on the life expectancy of the reservoir
- Effects of injection on reservoir characteristics
- Effects on regional thermal features

4.4.1 Effects on the Life Expectancy of the Geothermal Resource

The withdrawal of geothermal fluids during the operation phase of the proposed project would likely provide a substantial excess of reserve over that needed for this project. The proposed project would not significantly reduce the availability of fluids in the total geothermal reservoir contained within the Glass Mountain KGRA or significantly decrease the life expectancy of the system. The construction and decommissioning phases of the proposed project would not significantly affect the life expectancy of the proposed project.

Construction: The life expectancy of the geothermal resource is based on the amount of available geothermal fluids and the thermal energy contained in these fluids (i.e., their temperature). A substantial depletion of either of these factors would have a significant effect on the life expectancy of the geothermal resource. During the construction phase of the proposed action, production wells would be drilled and tested. Minimal amounts

of geothermal fluid would be removed from the geothermal reservoir during well testing. The withdrawal of this small amount of fluid would not substantially deplete the available geothermal fluids, and therefore would not affect the life expectancy of the geothermal reservoir.

Operation: At Fourmile Hill, Calpine proposes to operate a dual-flash energy conversion process (Calpine 1995). Wells would tap the zone of heated fluids (water and/or steam) within the reservoir. These fluids would rise under their own pressure and could flash (the transition from the liquid to gaseous state) in the reservoir and/or in the well. The fluids would continue to flow, under their own pressure, through surface pipes from the wellhead to the power plant, where the water and steam would be flashed and separated. The steam would drive turbine generators to produce electricity. The remaining water would be flashed again (hence dual flash) in a lower pressure separator to produce additional steam for routing to the low pressure turbine inlet. After passing through the turbine, hydrogen sulfide and other noncondensable gases are removed and the steam would be condensed to water in a direct-contact condenser. Water for the condenser would be cooled via circulation through cooling towers. The excess condensate in the cooling towers, also called blowdown, would be combined with residual geothermal water from the separators and returned to the reservoir via injection wells.

During the operation phase of the proposed project, geothermal fluids would be produced from the reservoir at estimated depths of 5,000 feet or deeper. The geothermal reservoir production zones would be faults associated with the caldera ring fracture system. Calpine proposes to generate 49.9 MW of electricity from steam produced from 9 to 11 production wells. Because no reservoir testing has been completed, the proportion of steam to water in the geothermal reservoir is not known; however, most geothermal reservoirs initially contain single-phase liquid water. With production and pressure drawdown, boiling within the reservoir often occurs, giving rise to two-phase conditions (i.e., water plus steam). Calpine estimates that production of 2.9 million pounds of geothermal water per hour would be required to produce the proposed amount of electricity. Table 4.4-1 shows the estimated amount of geothermal fluid produced, injected, and emitted from the cooling tower (Beall 1997).

The estimated maximum volume of fluids available for injection back into the geothermal reservoir would be 2.4 million pounds per hour, or 83.6 percent of the fluids produced. This estimate does not account for any other use of condensate or spent brines. Net loss of fluids from the geothermal reservoir as a result of project development would be 475,000 pounds per hour, or 16.4 percent of the fluid mass withdrawn. It is possible that some natural recharge to the geothermal reservoir occurs via the caldera ring fractures system; therefore, some of the fluids lost from the reservoir as a result of the proposed project may be replaced by natural hydrothermal processes.

Effect on Thermal Energy: Some loss of thermal energy may occur as a result of reservoir production. It is not uncommon for geothermal reservoirs to show fluid temperature declines over time. These declines are generally small and can reflect either a loss in thermal energy of the heat source or a reduction in residence time of recharge fluids while flowing through the reservoir rocks. Because the size of the heat source is

Table 4.4-1: Geothermal Fluid Mass Balance

Fate of Geothermal Fluid	Volume of Fluid (million pounds per hour)	Percent of Total
Produced	2.9	100
To steam generators	0.8	
Separated for injection	2.1	
Injected	2.425	83.6
Brine	2.1	
Condensate	0.325	
Emitted (cooling tower drift and evaporation)	0.475	16.4

Notes:

This mass balance makes the following assumptions:

- 16,000 pounds of steam required per MW produced
- Steam proportion of approximately 30 percent, including both low-pressure and high-pressure steam
- 55 percent evaporation rate from the cooling tower

SOURCE: CALPINE 1996

generally significantly larger than the reservoir volume, the recharge of thermal energy is usually rapid following cessation of fluid production. The actual levels of thermal depletion resulting from development of the proposed project cannot be determined until further drilling and reservoir testing have been completed. However, it is expected that thermal depletion would not be a significant impact and that thermal recharge would be rapid following facility decommissioning.

Under GRO requirements, the project proponent would be required to report to the BLM, on a regular basis, data regarding the geothermal reservoir and any changes that may occur as a result of production. These data would include reservoir temperature for individual wells. If there are any long-term effects to the reservoir, the BLM may require the developer to make appropriate changes to operational procedures, including production and injection rates and locations. These requirements would ensure that any impacts to the geothermal reservoir as a result of thermal depletion would not be significant.

Effect on Local Geothermal Reservoir: There are insufficient data regarding reservoir capacity and recharge processes to fully evaluate how the net loss of geothermal fluids would affect the longevity of the geothermal resource in the local Fourmile Hill area. However, Calpine completed a volumetric analysis to estimate the amount of available

geothermal fluids and evaluate the impact of the proposed project on this reservoir (Beall 1997).

The volume of reservoir fluid is primarily dependent on two factors:

- The thickness of the geothermal reservoir (the volume of the reservoir increases with thickness)
- The average porosity of the reservoir rocks (i.e., the amount of water contained in a given volume of rock)

A probable range of reservoir thickness would be from 1,000 feet to 5,000 feet, and porosity in a volcanic rock reservoir could range from 2 percent to 10 percent (Beall 1997). The volume of the geothermal reservoir in the Fourmile Hill area was estimated using a range of reservoir thicknesses (from 2,000 feet to 4,000 feet) and porosities (from 4 percent to 8 percent). Based on the calculated volume of reservoir fluids, the life expectancy of the local geothermal reservoir with implementation of the proposed project was then estimated. In order to make this estimation, the following four assumptions were made:

- The net rate of fluid withdrawal by the project would be 475,000 pounds per hour (see discussion above)
- No natural fluid recharge to the geothermal system takes place
- Only 50 percent of the geothermal fluids in the reservoir can ultimately be recovered
- 1,800 acres out of the 3,840 acres dedicated to the proposed project are productive

Using these assumptions and the range of reservoir thicknesses and porosities, the probable life expectancy of the local geothermal reservoir with implementation of the proposed project was estimated to range from 71 to 141 years (Beall 1997). This estimate is conservative because the ultimate fluid recovery rate could be higher than 50 percent and some amount of natural fluid recharge is expected. The proposed project would have a 45 year life span and would therefore not be expected to have a significant effect on the life of the geothermal resource.

Effect on Total Glass Mountain KGRA Geothermal Reservoir: Similar to the local Fourmile Hill geothermal reservoir, there are insufficient data regarding total reservoir capacity and recharge processes to fully evaluate how the net loss of geothermal fluids would affect the longevity of the Glass Mountain KGRA geothermal resource. However, it is expected that the net amount of geothermal fluids extracted would be small compared with the size of the potential resource in the Glass Mountain KGRA.

The effect of the proposed project on the life expectancy of the Glass Mountain KGRA geothermal resource can be roughly evaluated by comparing the total capacity of the KGRA with the proposed capacity of the project. The estimated capacity of the Glass Mountain KGRA geothermal resource is 500 MW for 30 years, or 15,000 MW-years (USFS and BLM 1984), and the proposed capacity of the project is 49.9 MW for 45 years, or 2,250 MW-years. Thus, if the actual reservoir capacity is 500 MW, the proposed project would consume approximately 15 percent of the total estimated capacity of the Glass Mountain KGRA reservoir. Based on this, the proposed project would be

expected to decrease the life expectancy of the Glass Mountain KGRA by approximately 15 percent.

The effect of the project on the life expectancy of the KGRA resource would be influenced by several factors that are not accounted for in this simple estimation. The following factors that would either increase or decrease the relative effect of the project on the life expectancy of the KGRA resource:

Increase the Effect of the Project

- As discussed in Section 3.3, the estimated capacity of the KGRA was made with very limited data and is probably an overestimate of the resource potential that can be economically developed. The effect of the project could be greater if the resource capacity is less than 500 MW.

Decrease the Effect of the Project

- Injection of geothermal fluids would prolong the life expectancy of the geothermal reservoir.
- If natural recharge of geothermal fluids occurs, it could prolong the life expectancy of the geothermal reservoir.
- The amount of electricity produced by the proposed project is subject to confirmation drilling and may be less than 49.9 MW.

These factors would not be expected to substantially increase the estimated effect of the proposed project on the life expectancy of the KGRA resource, and, in fact, could result in a net decrease in project effects. In conclusion, a 15 percent reduction in the life expectancy of the KGRA geothermal resource would be an adverse, but not significant effect.

Decommissioning: During the decommissioning phase, no geothermal fluids would be withdrawn from the reservoir. Therefore, the life expectancy of the reservoir would not be affected by this phase of the proposed action.

Mitigation Measures

The effect of the proposed project on the life expectancy of the geothermal reservoir in the Fourmile Hill area would not be expected to be significant. Implementation of the existing GROs and other applicable regulations would also serve to avoid significant adverse effects to the geothermal resource. No additional mitigation is recommended.

4.4.2 Effects of Injection on Reservoir Characteristics

Injection of waste geothermal fluids into the geothermal reservoir during the construction and operation phases of the proposed action is not expected to significantly change the temperature or chemistry of the reservoir. Injection would have a beneficial impact by helping to maintain reservoir pressures. No injection would occur during the decommissioning phase.

Construction: During construction of the proposed project, liquid drilling wastes might be injected into the geothermal reservoir. The volume of fluids injected would be relatively small and would have an adverse, but not significant effect on the temperature and chemistry of the geothermal reservoir. Injection of fluids would have a beneficial effect on the pressure of the geothermal reservoir.

Operation: Injection of spent geothermal fluids would occur on the periphery of the geothermal reservoir at depths similar to or greater than that of the production zone. Actual injection zones would be defined once the resource has been adequately delineated and characterized. Injecting the spent fluids back into the geothermal reservoir serves both as a method of disposal of excess produced geothermal fluids, as well as a way to maintain pressure within the reservoir.

Injected fluids have similar composition to that of fluids produced, with the exception that some constituents such as total dissolved solids may have higher concentrations. The increased concentrations result from flashing and removal of steam from the total fluid. The injection of gray water sewage treatment system would also result in minor alterations of the fluid chemistry. However, the volume of gray water injected would be very small relative to the volume of spent geothermal fluids, and would not result in substantial changes in the fluid composition.

During the operation phase, approximately 2.4 million pounds per hour of fluids would be injected into the geothermal reservoir. Injection of these fluids may result in some localized lowering of reservoir temperatures in the vicinity of the injection wells because injected fluids would be at a lower temperature than production fluids. Without sufficient spatial separation of production and injection wells, the localized temperature reductions could adversely affect the productivity of the production wells. Some minor changes in reservoir chemistry would also occur because injected fluids would have lower concentrations of noncondensable gases. The spatial separation of production and injection wells planned by Calpine would minimize any adverse impacts on the geothermal resource as a result of injection of geothermal fluids. Evidence from other geothermal systems suggest that injection of fluids could have an adverse, but not significant effect on the temperature and chemistry characteristics of the geothermal reservoir.

The zones into which geothermal fluid would be injected would not be determined until more geothermal reservoir data are available. However, it is normal practice that fluids are injected into the reservoir in a manner and at a location that would maintain the pressure within the geothermal system and allow maximum extraction of unused geothermal fluids. The difference in location of the production and injection wells could cause some minor changes to the pressure distribution within the geothermal system. Overall, however, injection of spent geothermal fluids will have a positive impact on reservoir pressures.

Under GRO requirements, the project proponent will be required to report data regarding the geothermal reservoir pressure and chemical characteristics and any changes that may occur as a result of production. If there are any long-term effects to the reservoir, the BLM may require the developer to make appropriate changes to operational procedures, including production and injection rates and locations. These requirements would ensure that effects of fluid injection on the geothermal reservoir would be less than significant.

Decommissioning: During decommissioning, no geothermal fluids would be injected into the reservoir. Therefore, there would be no effect from injection during this phase.

Mitigation Measures

4.4.2a The injection program shall be designed to avoid interference with temperature or chemical characteristics of production fluids as a result of injecting waste fluids. (C,O)

Level of Significance After Mitigation

Less than significant.

4.4.3 Effects on Regional Thermal Features

The construction, operation, and decommissioning of the proposed project is not expected to affect thermal features in the project region.

Construction: During the construction phase of the proposed action, only a small amount of geothermal fluid would be removed from the reservoir. Withdrawal of this small fraction of the reservoir would not affect any regional thermal features.

Operation: Operation of the proposed project would involve a net loss in geothermal fluids in the reservoir and would include injection of spent fluids (at reduced temperatures) back into the reservoir. These activities could potentially affect regional thermal features that share the same geothermal reservoir or heat source; however, there are no regional thermal features that are believed to share the same reservoir or heat source.

As described in Section 3.4, the only known surface thermal feature in the Medicine Lake Highlands is the Hot Spot located on the northwest flank of Glass Mountain (Figure 3.3-2). The Hot Spot is a pair of fumaroles that emit gases heated by the magma. It is not a hydrologic feature and would not be affected by the production of geothermal fluids. In addition, the Hot Spot is a very isolated and presumably locally constrained feature. Its location within the caldera and approximately 5 miles from the proposed wellfield indicate that it would not be impacted by the proposed production activities.

Low temperature springs and wells have been noted in the Butte Valley and in the area north of Fall River. The features occur along, and in association with, regional fracture systems and are located more than 20 miles from the project area. High-temperature geothermal systems, such as those related to the magmatic heat source at Medicine Lake, are restricted in areal extent by the dimensions of the heat source. Low temperature systems associated with fault zones almost always result from deep circulation and heating of groundwater rather than by direct magmatic association. Therefore it is reasonable to assume that these features do not share the same heat source or geothermal reservoir as the proposed project. No impacts to these features would be expected as a result of the proposed action.

Decommissioning: During the decommissioning phase, no geothermal fluids would be withdrawn from the reservoir; therefore, there would be no effect on local or regional thermal features.

Mitigation Measures

No effects are expected, and no mitigation is recommended.

ALTERNATIVES

For Alternatives 2 through 6, potential impacts associated with the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Construction of the proposed transmission line or any of the alternative routes would not impact geothermal resources. For this reason, the impacts on geothermal resources would be the same for Alternatives 2 through 6 as described under the proposed action. Alternative 7, the No Action alternative, would avoid effects to the geothermal resource that could occur under the proposed action or under Alternatives 2 through 6.

4.5 Cultural Resources

REGULATORY FRAMEWORK

Several Federal and state laws and Executive Orders require the consideration of cultural resources. These include:

- National Historic Preservation Act of 1966, as amended
- Native American Graves Repatriation Act
- National Environmental Policy Act
- California Environmental Quality Act

Section 106 of the National Historic Preservation Act (NHPA) requires that Federal agencies take into account the effects of their undertaking on properties included in or eligible for the National Register of Historic Places (NRHP), and afford the President's Advisory Council on Historic Preservation (ACHP) the opportunity to comment on such actions. This procedure is often called the Section 106 process. The 1980 amendments to the NHPA directed the Secretary of the Interior to study means of "preserving and conserving the intangible elements of our cultural heritage such as arts, skills, folklife, and folkways..." and to recommend ways to "preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions that underlie and are a living expression of our American heritage" (NHPA §502; 16 USC 470a note as cited in NPS 1992).

The Federal lead agency for the proposed action is responsible for initiating the Section 106 process and for consultation with the State Historic Preservation Officer (SHPO) and the ACHP. For the proposed project, the USFS, as the Surface Managing Agency, will be responsible for initiating the Section 106 process and for coordinating with the SHPO and the ACHP. The Section 106 process starts with considering the broad environmental consequences of an undertaking, then progressively narrowing the focus until specific problems can be identified, understood, and resolved. Identification and evaluation of the historic resources within a project's area of potential effects is the first step of the process. Subsequent steps involve consideration of effects, which may be followed by additional consultation with SHPO and the ACHP, as well as other interested parties.

The Native American Graves Protection and Repatriation Act (NAGPRA) requires consultation with appropriate Indian tribes prior to the excavation of human remains or cultural items (including funerary objects, sacred objects, and cultural patrimony) on Federal lands. NAGPRA recognizes Native American ownership interests in some human remains and cultural items found on Federal lands and makes illegal (under most circumstances) the sale or purchase of Native American human remains, whether or not they derive from Federal or Indian lands. Repatriation, on request, to the culturally affiliated tribe is required for human remains and associated funerary objects. Repatriation of other cultural items is dependent upon whether or not the original acquisition of an item was from an individual with the authority to alienate it from the tribal group (43 CFR Part 10).

NEPA and CEQA also require that agencies consider the effects of their actions on the cultural environment. NEPA and CEQA provide the opportunity to look at the effects of projects on historic, prehistoric, cultural, and social environments.

KEY ISSUES

The key cultural resources issues identified and evaluated in this section relate to the effects of the project on historic and archaeological resources. This effect is evaluated in Impact 4.5.1.

SIGNIFICANCE CRITERIA

Federal law requires the consideration of effects to historical and cultural resources prior to authorizing any activity, while state law requires the protection of historical and cultural resources (see the regulatory framework discussion in this section).

A proposed project would be considered to have a significant effect on cultural resources if it would adversely affect a resource that is listed or has been determined to be eligible for listing on the NRHP. The California Environmental Quality Act (CEQA) Guidelines provide the framework for evaluating potential impacts of a proposed project on cultural resources at the state level. Pursuant to Section 15065(a) of the CEQA Guidelines, the elimination of "important examples of the major periods of California history or prehistory" would be a significant impact on the environment. Appendix G of the CEQA Guidelines states that a project will normally have a significant effect on the environment if it will "disrupt or adversely affect a prehistoric or historic archaeological site or a property of historic or cultural significance to a community or ethnic or social group." Appendix K of the CEQA Guidelines states that a significant negative impact on the environment would be caused by the disruption or destruction of an "important archaeological resource," which is defined as a resource that:

- Is associated with an event or person of recognized significance in California or American history, or recognized scientific importance in prehistory
- Can provide information which is both of demonstrable public interest and useful in addressing scientifically consequential questions
- Has a special quality such as oldest, best example, largest, or last surviving example of its kind
- Is at least 100 years old and possesses substantial stratigraphic integrity
- Involves important research questions that historical research has shown can be answered only with archaeological methods

METHODOLOGY

The impact analysis for cultural resources is based on the information gained from the Class III survey of the wellfield, the sample survey of the proposed and alternate transmission line corridors, and literature search results, as well as on information about the proposed project's construction, operation, and decommissioning phases. See the Methodology subsection in Section 3.5, Cultural Resources, for the Class III and sampling survey and literature review methodology.

IMPACT OVERVIEW

Two sites were located during the Class III cultural resources inventory of the areas of effect in the wellfield and power plant area. The sites would not be subject to adverse effects from the proposed action. Sample surveys and record search data for all proposed and alternate transmission line segments indicate that the cultural resource sites in the project area are not evenly distributed along the proposed and alternate transmission line segments. A and B segments contain much lower densities of cultural resources sites than C segments (see Table 4.5-1). These results indicate that project construction, operation, and decommissioning activities along the C segments of the project may require mitigation measures to avoid significant impacts.

PROPOSED ACTION (ALTERNATIVE 1)

The potential impacts associated with the construction, operation, and decommissioning of the proposed project on both prehistoric and historic cultural resources are discussed below. Boundary definition and flagging would allow the avoidance of cultural resource sites located in the wellfield and power plant area and along the proposed transmission line route. Approval of the proposed action would require a complete archaeological survey of the proposed transmission line route and implementation of mitigation prior to construction. Local tribes also would be consulted regarding mitigation (see Section 4.6). The wellfield and power plant project areas already have been intensively surveyed. Any impacts to undiscovered prehistoric or historic sites found as a result of project activities would be mitigated. Mitigation measures for the proposed action are provided later in this section.

4.5.1 Effects on Cultural Resources From Surface Disturbance

Although implementation of the proposed action will result in surface disturbance, geothermal development activities within the project area will have no adverse impacts on surface and subsurface prehistoric and historic resources.

Construction: Approximately 49.7 acres of surface disturbance would occur as a result of grading for construction of the wellfield and power plant area (including the freshwater pipeline corridor and associated access roads) (see Table 2.2-1). Additional impacts to cultural resources located in the wellfield and power plant area and along the freshwater pipeline could occur as a result of off-road vehicle traffic during construction.

Any potential impacts to the prehistoric quarry located within the wellfield and power plant area as a result of surface disturbance may be avoided by placing the production/injection line a minimum of 100 feet from this prehistoric site. The historic site located in the vicinity of the wellfield and power plant area is an active USFS road and is unlikely to be determined eligible for the NRHP due to the disturbed nature of the site. The project is not expected to cause additional adverse impacts to this site. Placement of the freshwater pipeline is not expected to have any effects upon cultural resources in the area because of the lack of cultural resources located along the corridor. In addition, the pipeline requires minimal construction activity for set-up; no grading or excavation is required.

Table 4.5-1: Estimated Number of Sites within the Proposed and Alternate Transmission Line Corridors

	Segments A and B			Segment C			
Sites	Length Estimated (miles)	Density per Mile	Number of Sites	Length (miles)	Density per Mile	Number of Sites	Total
Proposed Action (Alternative 1)	15.17	0.9	13.7	8.27	6.2	51.3	65.0
Alternative 2	15.17	0.9	13.7	9.66	6.2	59.9	73.6
Alternative 3	17.46	0.9	15.7	8.27	6.2	51.3	67.0
Alternative 4	17.46	0.9	15.7	9.66	6.2	59.9	75.6
Alternative 5	14.95	0.9	13.5	8.27	6.2	51.3	64.8
Alternative 6	14.95	0.9	13.5	9.66	6.2	59.9	73.4

SOURCE: FWARG 1996

Surface disturbance would occur within the proposed transmission line route, and outside of the transmission line study corridor where access roads, the substation site, construction lay-down areas, and other activities would be located. Transmission line construction would result in a maximum of 335.8 acres of surface disturbance along the transmission line route. Additional surface disturbance could occur during the construction phase along the proposed transmission line route as a result of off-road vehicle traffic. The USFS would require that no unmitigated effect to cultural resources occur as a result of this project. The USFS would also require that inspection for and identification of cultural resources be completed prior to land-disturbing activities. Any sites that are identified would be flagged and avoided, and any impacts to these sites would be mitigated. Where possible, transmission lines would be designed to avoid resources. At any sites where the transmission line cannot avoid a cultural resource, effects would be mitigated by various methods as determined by a qualified archaeologist or cultural resource specialist. Mitigation could include data recovery.

Potentially, undiscovered prehistoric and historic resources still exist buried within or immediately adjacent to the wellfield and power plant site, freshwater pipeline, and transmission line route. Excavation in the wellfield and power plant site and along the proposed transmission line route could encounter unrecorded cultural resources. Destruction or unauthorized collection of an unrecorded cultural resource would be considered a significant impact.

Operation: Maintenance activities of project facilities in the wellfield and power plant area, along the freshwater pipeline, or along the proposed transmission line route may have the potential for direct effects to cultural resources through surface disturbance such as off-road traffic, worker encroachment, or additional blading or vegetation

removal. Any emergency access required for project operation would have the potential to directly affect cultural resources through off-road vehicle traffic or other activities. Accidental spills that could occur from the power plant area or from the freshwater pipeline during operation also have the potential to directly affect cultural resources through soil erosion or chemical contact. In addition, cultural resource sites could be affected by unauthorized artifact collection by maintenance crews, emergency workers, and/or the public.

Decommissioning: As part of the decommissioning phase, the project area would be generally returned to pre-project conditions. Decommissioning would involve the dismantling of all project facilities, including the power plant, pipelines, well pad equipment, and transmission line. If these activities occur within the existing limits of any disturbance that was a result of construction, then no impacts are expected from decommissioning. To avoid any effects from decommissioning, cultural resource site boundaries may need to be well defined and flagged where transmission line poles are located in close proximity to significant resources. The potential for illegal collection of artifacts by project workers exists throughout the decommissioning phase.

Mitigation Measures

4.5.1a To comply with Federal requirements pertaining to cultural resources, a qualified archaeologist (on behalf of Calpine) shall survey, identify, and record cultural resources within the proposed transmission line corridor and where ground disturbance outside of the corridor would occur due to access roads, lay-down areas, and other associated sites. The survey shall be conducted prior to the commencement of surface disturbing activities for the proposed project. Preliminary construction plans should be overlaid on the cultural resources base maps to identify where surface disturbance will likely occur that may impact a cultural resource. Transmission facilities shall be relocated to avoid historic and prehistoric sites where possible and practical. If avoidance is not feasible, it will be necessary to evaluate each potentially affected site in order to determine if the site is eligible for listing under NRHP criteria. Evaluation of prehistoric sites may include some amount of surface collection and subsurface excavation; evaluation of historic sites may include focused archival study, field recordation, and/or surface collections and subsurface probing as part of data or resource recovery methods.

4.5.1b At sites already determined eligible, prior evaluation and mitigation efforts (where conducted) shall be thoroughly reviewed to better assess the effects that this undertaking will have on the property, prior to construction activities. An effort shall be made to relocate transmission facilities, where possible and practical, so that impacts are restricted to areas previously mitigated within eligible properties and remaining intact deposits are not affected. At some eligible sites, it may be necessary to evaluate deposits within the right-of-way to determine the appropriate course of action, as determined by a qualified archaeologist or cultural resource specialist. At historic sites, evaluation may include archival study and/or field recordation.

4.5.1c Avoid cultural resources wherever possible. To ensure that construction activities do not encroach on cultural resources slated for avoidance, sensitive areas shall be flagged prior to surface-disturbing activities, supervisory construction personnel shall be briefed on these locations (and the consequences of encroachment). And, the areas shall be monitored once every week during construction activities by a qualified archaeologist to ensure sites are protected/avoided.

4.5.1d Construction activities and the production/injection line shall be routed a minimum of 100 feet from the northern boundary of the prehistoric quarry identified at the power plant site. The construction area shall be defined and flagged, with a USFS representative and a cultural resource specialist or archaeologist in attendance, prior to construction. If avoidance is not feasible,

the resource specialist shall evaluate the prehistoric site to determine if it is eligible for listing on the NRHP. If it is eligible, data recovery methods, such as collecting surface and subsurface resources shall be pursued as determined by the resource specialist. In addition, it is recommended that no evaluation of the historic site identified at the wellfield and power plant site be undertaken, provided that the proponent's use of USFS Road 44N64 remains as a roadway and does not involve any surface disturbing or subsurface activities, such as grading or excavation adjacent to the roadway.

4.5.1e Construction workers and other persons directly involved with on site activities for the proposed project, including maintenance crews, shall be informed of the sensitivity of the area for cultural resources, and instructed to refrain from unauthorized prehistoric and historic resource collection. All construction workers and other persons directly involved with on-site activities for the proposed project shall be required to sign an agreement recognizing the fragile nature of prehistoric resources and acknowledging that unauthorized collection of said resources is a crime.

4.5.1f If prehistoric archaeological resources are discovered during construction, all work in the immediate vicinity shall be suspended pending site investigation by the USFS and a qualified archaeologist to assess the materials and determine their significance. After halting construction in the area that previously undiscovered resources are found, the resource will be recorded and it will be determined if the project could be re-routed to avoid any additional effects. If avoidance is not feasible, the site will be evaluated by a qualified archaeologist and a determination of eligibility for the NRHP shall be made. If the site is determined to be eligible, then a mitigation proposal (which may include a data recovery program similar to those conducted for similar resources in the vicinity) shall be submitted with the site record to the State Office of Historic Preservation (SOHP) for review and concurrence.

4.5.1g If prehistoric archaeological deposits that include human remains or objects considered "cultural items" according to the Native American Graves Protection and Repatriation Act are discovered during construction, the County Coroner and a qualified archaeologist shall be notified immediately and NAGPRA regulations shall be followed. If the remains are identified as American Indian, the tribe(s) shall be notified within one (1) working day and consultation will be initiated. Project activities may resume 30 days after notifying the tribe(s). Repatriation of the other categories of items (funerary objects, sacred objects, and cultural patrimony) shall be based on evidence that indicates whether or not the original acquisition of the object was from an individual that had the authority to separate the item from the tribal group.

4.5.1h If avoidance of previously undiscovered prehistoric archaeological resources is not be feasible, an evaluation of the resources shall be required and conducted by a qualified archaeologist or cultural resources specialist. An evaluation plan would be developed by the archaeologist and would consist of the methodical excavation of those portions of the site(s) that would be adversely affected. Only a qualified archaeologist or cultural resources specialist shall be allowed to collect any prehistoric resources discovered at the site. The work shall be accomplished within the context of a detailed research design and in accordance with current professional standards. The plan shall result in the extraction of sufficient volumes of non-redundant archaeological data so as to address important regional research consideration, detailed technical reports shall be prepared to document the findings.

4.5.1i Maintenance and emergency plans to be developed by Calpine and required for project operation shall include maps of cultural resources that clearly outline site boundaries. Project maintenance and emergency plans shall ensure that successful implementation of these activities can occur without the encroachment of cultural resource sites.

4.5.1j Plans for project operation shall ensure that spills of hazardous material or geothermal fluids are rapidly contained so that cultural resource sites area not affected in the case of such an event.

Level of Significance After Mitigation

Less than significant.

ALTERNATIVES

The potential effects and recommended mitigation measures for each alternative to the proposed action are described below. For Alternatives 2 through 6, potential impacts associated with the proposed wellfield and power plant area would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of potential impacts along these portions of the transmission line are not repeated under each alternative discussion. The analysis of the impacts of the alternatives focuses on the effects that would be different from those identified for the proposed action. Table 4.5-1 provides an overview of the density of sites that are predicted along the proposed and alternate transmission line routes. Based on the information gathered, project impacts on cultural resources would be similar for all alternatives.

Alternative 2 (Segments A1, A2, B1, and C2)

Alternative 2 differs from the proposed action by the substitution of transmission line segment C2 for segment C1 and two different potential locations for the substation at the end of the transmission line. The effect of Alternative 2 on cultural resources that are currently identified would be similar to those for the proposed action, although the sites along segment C1 would be avoided. Segment C2 is longer than segment C1 of the proposed action. The mitigation measures identified for the proposed action would apply to Alternative 2, as well. All of the impacts would be less than significant after mitigation.

Alternative 3 (Segments A1, B2, and C1)

Alternative 3 differs from the proposed action by the substitution of transmission line segment B2 for segments A2 and B1. This transmission line route extends south of Red Shale Butte and Lyon's Peak before heading north to connect with segment C1. The effect of Alternative 3 on cultural resources would be generally the same as for the proposed action.

Throughout the construction phase, the two sites (MOD-1718/1719/1720H, MOD-3096H) determined eligible for inclusion on the NRHP along this transmission line route (MOD-3096H also is included in the proposed action) would require flagging and avoidance. Complete surveys along this transmission line corridor would identify any additional resources, and no impacts on cultural resource sites would occur due to avoidance. Implementation of the mitigation measures listed for the proposed action would ensure no significant effects to any cultural resources discovered during project activities. The mitigation measures identified for the proposed action would apply to Alternative 3. All of the impacts would be less than significant after mitigation.

Alternative 4 (Segments A1, B2, and C2)

Under Alternative 4, segment B2 would replace segments A2 and B1. Alternative 4 is the same as Alternative 3, except that the transmission line follows segment C2 north to avoid Tionesta, rather than following segment C1. The effect of Alternative 4 on cultural

resources would be the same as for the proposed action, considering those cultural resource sites now identified. The mitigation measures identified for the proposed action would apply to Alternative 4. All of the impacts would be less than significant after mitigation.

Alternative 5 (Segments A3, B1, and C1)

Alternative 5 differs from the proposed action by the substitution of transmission line segment A3 for segments A1 and A2. Segment A3 extends north from the power plant, passing to the west of Fourmile Hill and then extends east following a route to the north of Mt. Hoffman. The effects of Alternative 5 on cultural resources would be similar to the proposed project.

A complete survey would identify the cultural resources located within this transmission line route, in addition to two sites (MOD-1718/1719/1720H, MOD-3096H) that have already been determined eligible for the NRHP (site MOD-3096H is also included in the proposed action). Cultural resource sites identified would be flagged and avoided. Mitigation measures for sites that cannot be avoided completely would ensure that any impacts are not significant. The mitigation measures identified for the proposed project would apply to Alternative 5. All of the impacts would be less than significant after mitigation.

Alternative 6 (Segments A3, B1, and C2)

Under Alternative 6, segment A3 would replace segments A1 and A2, and segment C2 would replace segment C1. Alternative 6 is the same as Alternative 5 except that it follows segment C2 north to avoid Tionesta, rather than following segment C1. The effects of Alternative 6 on cultural resources would be generally the same as for the proposed action, considering the cultural resource sites identified at this time. The mitigation measures identified for the proposed project would apply to Alternative 6, as well. All of the impacts would be less than significant after mitigation.

Alternative 7

Cultural resources would not be affected by the implementation of Alternative 7, the No Action alternative. No mitigation measures would apply to this alternative.

4.6 Traditional Cultural Values

INTRODUCTION

This section is designed to focus on issues of concern and effects to the local American Indian community. The analysis addresses the potential for the construction, operation, and decommissioning of the proposed project to affect tribal members, traditional use sites and practices, and the spiritual values in the region. The impact analysis is based on information about American Indian values and project effects gathered from tribal member interviews and meetings with the local tribes for this and other projects. The effects to historic and prehistoric resources are addressed in Section 4.5, Cultural Resources.

REGULATORY FRAMEWORK

Consideration of issues of concern to the American Indian community is required under several Federal and state laws and Executive Orders, including:

- National Historic Preservation Act of 1966, as amended
- American Indian Religious Freedom Act of 1978
- Executive Order 13007
- Executive Order 12898
- National Environmental Policy Act (NEPA)
- California Environmental Quality Act (CEQA)

Section 106 of the National Historic Preservation Act (NHPA) of 1966 (as amended) requires that Federal agencies take into account the effects of their undertaking on properties included in or eligible for the National Register of Historic Places (NRHP), and afford the President's Advisory Council on Historic Preservation (ACHP) the opportunity to comment on such actions. This procedure is often called the Section 106 process. The 1980 amendments to the NHPA directed the Secretary of the Interior to study means of "preserving and conserving the intangible elements of our cultural heritage such as arts, skills, folklife, and folkways..." and to recommend ways to "preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions that underlie and are living expressions of our American heritage" (NHPA §502; 16 USC 470a note as cited in NPS 1992).

The Federal lead agency for the proposed project is responsible for initiating the Section 106 process and for consultation with the State Historic Preservation Officer (SHPO) and the ACHP. The Section 106 process starts with considering the broad environmental consequences of an undertaking; as research progresses, specific problems, if any, can be identified, understood, and hopefully resolved. Identification of the historic resources within a project's area of potential effects is the first step of the process. Subsequent steps involve consideration of effects and possibly evaluation, which may be followed by additional consultation with SHPO and the ACHP, as well as other interested parties.

In addition to the Section 106 process other regulations are considered in the evaluation. The American Indian Religious Freedom Act (AIRFA), Public Law 95-341, states that "...it shall be the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions...including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites."

Executive Order 13007, "Indian Sacred Sites" (of 1996) directs that Federal agencies, "to the extent practicable," accommodate access to and avoid adverse effects to the physical integrity of sacred sites. Agencies are required to provide reasonable notice of proposed actions that may "...restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites."

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (of 1995)provides that "each Federal Agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." Environmental justice issues, specifically impacts to Native Americans, are addressed in this section, as well as in Section 4.16, Socioeconomics (Impact 4.16.4, Effect on Minority and Low-Income Populations).

NEPA and CEQA also require that agencies consider the effects of their actions on the cultural environment. NEPA and CEQA provide the opportunity to look at the effects of projects on historic, prehistoric, cultural, and social environments.

KEY ISSUES

The key tribal issues identified and evaluated in this section relate to the effects of the project on traditional cultural sites, on access to traditional sites, and on traditional cultural uses and values. These effects are evaluated in impact statements 4.6.1, 4.6.2, 4.6.3, 4.6.4, and 4.6.5.

SIGNIFICANCE CRITERIA

CEQA Guidelines provide the framework for evaluating potential impacts of a proposed project on cultural resources at the state level. Pursuant to Section 15065(a) of the CEQA Guidelines, the elimination of "important examples of the major periods of California history or prehistory" would be a significant impact on the environment. Appendix G of the CEQA Guidelines states that a project will normally have a significant effect on the environment if it will:

- Disrupt or adversely affect a prehistoric or historic archaeological site or a property of historic or cultural significance to a community or ethnic or social group
- Conflict with established recreational, educational, religious, or scientific use of an area

Appendix K of the CEQA Guidelines states that a significant negative impact on the environment would be caused by the disruption or destruction of an "important archaeological resource," which is defined as a resource that:

- Is associated with an event or person of recognized significance in California or American history, or recognized scientific importance in prehistory
- Can provide information which is both of demonstrable public interest and useful in addressing scientifically consequential questions
- Has a special quality such as oldest, best example, largest or last surviving example of its kind
- Is at least 100 years old and possesses substantial stratigraphic history
- Involves important research questions that historical research has shown can be answered only with archaeological methods

The American Indian Religious Freedom Act (PL 95-341) states that it is "...the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian ... including but not limited to access to sites, use and possession of sacred objects, and freedom to worship through ceremonials and traditional rites." The proposed project would have a significant effect if it were inconsistent with this policy and denied American Indian rights of freedom to exercise religion or access to sites.

Section 106 of the National Historic Preservation Act defines the following criteria of adverse effect to sites on or eligible for listing on the National Register of Historic Places as occurring "under conditions which include but are not limited to":

- Destruction or alteration of all or part of a property
- Isolation from or alteration of its surrounding environment
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting
- Transfer or sale of a Federally owned property without adequate conditions or restrictions regarding preservation, maintenance, or use
- Neglect of a property resulting in its deterioration or destruction

METHODOLOGY

The methodology for analyzing effects on traditional cultural values is described in Section 3.6, Traditional Cultural Values, of this document. The effects of the project on traditional properties and values were evaluated in the context of the regulations, laws, and orders identified above, including:

- Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties,* which represents the advice of the National Register about how agencies should identify and evaluate traditional cultural properties or places
- The American Indian Religious Freedom Act (PL 95-341), which states Federal policy to protect American Indian rights to exercise traditional religions
- *Criteria for Evaluation,* the National Register's guidance on evaluation of properties
- Section 106 of the National Historic Preservation Act, which requires Federal agencies to make a good faith effort to identify historic places or properties that are eligible for listing on the National Register of Historic Places

- CEQA significance criteria

The analysis of the effects of the project on traditional cultural values is based primarily on:

- Tribal concerns presented during on-going government-to-government consultation meetings with the Klamath Tribes, the Pit River Nation, and Shasta tribal members, and
- Data gathered in the interviews with tribal consultants and field verification of sites, as described in the ethnographic study conducted for this EIS/EIR (Theodoratus and Emberson 1996; Theodoratus, et al. 1998) (see Section 3.6, Traditional Cultural Values)

During the consultation process, tribal members expressed concern with land use issues that are not related to impacts of the proposed project. The impact discussion in this EIS/EIR focuses on the impacts of this project and the agency decisions related to this project. Issues and concerns raised by local tribes that range beyond project-specific issues and are related to USFS management practices would need to be addressed in other documents.

The locations and values identified during the interviews with tribal consultants were reviewed in reference to the locations and surface disturbance footprint of the proposed project facilities as well as the locations of the alternatives to the proposed project. The specific sites identified by tribal consultants were located on a topographic map and compared to the proposed locations for project facilities. The sites were not verified in the field and specific boundaries were not defined prior to completion of the Draft EIS/EIR. The sites were verified in the field in 1997, subsequent to the publishing of the Draft EIS/EIR. All but two of the identified traditional use sites were verified in the field (Theodoratus, et al. 1998).

The research initiated by Dr. Theodoratus (Theodoratus and Emberson 1996; Theodoratus, et al. 1998) was completed prior to the completion of the Final EIS/EIR.. The additional study included an extended literature search to further document use by the identified and neighboring tribes. Additional interviews and site visits were also conducted by the ethnographer to record information about the use and extent of the site. The sites were visited by the ethnographers, archaeologists, and the tribal consultants. While the sites were located in the field and surface manifestations were recorded, the full extent of the sites' information was recorded on ethnographic site report forms to provide consistent recordation. The sites will be evaluated by the USFS archaeologists to determine if the identified sites qualify under the National Register definition of a site. The National Register (Bulletin 15, *Guidelines for Applying to the National Register Criteria*) defines a site as:

> "...the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the location itself possesses historic, cultural, or archaeological value regardless of the value of any existing structure."

The traditional sites will be evaluated for their integrity of relationship and condition (prior to the decision on the project). The sites will then be evaluated for eligibility for

listing on the National Register. The USFS will continue to consult with the affected tribes throughout this process.

The impact analysis considered the physical effects of the project on traditional cultural values that could result from project-related surface disturbance, as well as effects of noise and view alteration. The effects on the visual, aural, olfactory, and spiritual sense of the site were also considered, recognizing that all of these elements contribute to the spiritual environment at a site.

Tribal statements, concerns about project effects, and recommendations from the consultations, and the interviews were reviewed for this analysis. Impacts were considered in terms of the issues identified by the tribes and mitigation measures were designed to reduce effects. Topics of concern to tribal members, such as hydrology (Sections 3.3 and 4.3), cultural resources (Sections 3.5 and 4.5), vegetation (Sections 3.7 and 4.7), wildlife (Sections 3.8 and 4.8), noise (Sections 3.14 and 4.14) and visual resources (Sections 3.9 and 4.9) are each considered separately in this document, as well as being summarized in this section.

PROPOSED ACTION (ALTERNATIVE 1)

Overview of Impacts

This analysis is organized to address key impacts of the proposed project on traditional cultural values (the effects on historic and prehistoric resources are addressed in Section 4.5 of this EIS/EIR). Under each impact statement, the effects of the proposed construction, operation, and decommissioning of the project are addressed. After each impact statement, mitigation measures are defined in an attempt to reduce or eliminate any significant effects. In some cases, mitigation measures from other impact analyses in this document are referenced when measures from another section would also reduce the significance of the effect (e.g., noise mitigation measures from Section 4.14, Noise). The project impacts addressed in this section include:

4.6.1 Effects on Medicine Lake Highlands

4.6.2 Direct Effects on Traditional Sites in the Medicine Lake Highlands

4.6.3 Effects of Noise on Traditional Uses

4.6.4 Effects on Access to Traditional Sites

4.6.5 Effects on Traditional Religious Practices

4.6.6 Effects on Landscape Views

4.6.7 Effects on Natural and Other Resources in the Project Region

4.6.8 Effects of Amending the Klamath National Forest Land and Resource Management Plan Standard 24-25

American Indian consultants identified specific traditional-use sites during interviews for the proposed project (Theodoratus and Emberson 1996; Theodoratus et al. 1998). The tribes have requested that place names and locations of sites remain confidential and not be disclosed to the public in this EIS/EIR. The identified sites are therefore referred to by number in this analysis. The numbers are keyed to a table and map contained in the *Ethnographic Report* (Theodoratus and Emberson 1996; Theodoratus et al. 1998) prepared for the project.

The proposed project would not result in surface disturbance or affect the physical integrity of the individual sites identified by tribal members. Mitigation measures would be implemented to eliminate the potential for direct impacts to sites. The project would have the potential for significant effect due to the potential for conflict with established American Indian religious practices. The project would not deny access to any identified traditional or religious use site, or deny the right to conduct traditional or religious practices. The project activities and elements may be seen or heard from some identified sites. Tribal members believe the project would have a significant, adverse effect on the entire Medicine Lake Highlands. Mitigation is proposed to reduce the effect of the project, but may not fully mitigate the effects to traditional cultural values and uses in the area.

Traditional Use

The ethnographic literature research for the proposed project demonstrated that there exists a historical use pattern of the region by local indigenous peoples. These literature data, in conjunction with data collected as part of the field ethnographic research on the proposed project area and collected for other USFS projects in the area, substantiate this use pattern(Theodoratus et al. 1998).

Dr. Dorothea Theodoratus conducted 31 interviews with tribal consultants of the Klamath, Pit River, and Shasta tribes in an effort to:

- Identify sites traditionally used by American Indians in the project region
- Identify specific tribal concerns about the proposed project
- Determine the impacts of the proposed project on traditional cultural values

This research was conducted in support of the tribal consultation for the proposed geothermal project and was designed to assist in the preparation of this EIS/EIR analysis.

4.6.1 Effects on Medicine Lake Highlands Area

The proposed project is considered by local tribes to have a significant effect on Medicine Lake Highlands. The project would not remove the right of the tribes to practice their religion or deny access to traditional use sites. The proposed project could conflict with established religious use of the Medicine Lake Highlands and would introduce visual and audible elements that are out of character with the area. The effects are considered significant and unavoidable under CEQA. Mitigation defined throughout this EIS/EIR would serve to reduce, but not eliminate the significant unavoidable impacts.

Construction: Information obtained from the literature search accentuates the spiritual/religious meaning of the Medicine Lake Highlands region to local and peripheral tribes. The literature search documented that the Medicine Lake Highlands was historically a key area for obtaining obsidian important in intertribal trade, and that resident tribes allowed non-residents access to use the Highlands (see Theodoratus et al. 1998 for a detailed discussion of the use and values at the Medicine Lake Highlands area).

The data obtained in the interviews with American Indian consultants indicate that tribal members believe the project would have a significant, adverse effect on the spirituality of the Medicine Lake Highlands. The interviews indicate that local tribes do not consider proposed project effects according to specific sites, but rather the effect the project would have on the Medicine Lake Highlands region. For instance, tribal members have stated that the Medicine Lake Highlands and Timber Mountain are each considered single cultural properties, but that they view these sites as part of an integrated, whole landscape (the Medicine Lake Highlands). According to some tribal consultants, the whole landscape of the Medicine Lake Highlands, and all of the spiritual values associated with it, are affected by the proposed project, not just specific sites.

The consulted tribes conceive of the Medicine Lake Highlands and Timber Mountain areas as a unit with particular interconnected qualities. Within the Medicine Lake Highlands there exist specific topographic features that have been traditionally used by indigenous peoples. Access to and use of these areas is considered by some members of the consulted tribes to be germane to tribal identity. Project construction was originally thought to potentially have a direct effect on one specific traditional site (site #14, see impact statement 4.6.2 below) identified through tribal consultant interviews (Theodoratus and Emberson 1996). However, this site could not be located in the field by the ethnographic research team or the tribal consultants. This site would not be affected by the proposed project as it was not located within or near the study corridor. Implementation of the proposed project would, however, result in alteration of the environment of the Medicine Lake Highlands.

While the noise and activity associated with construction would occur over a relatively short-term period, the result of construction would be a long-term (45 year) presence of an industrial facility in an area with significant spiritual values. The proposed project would introduce an industrial project with visual and audible elements that would be out of character with the environment of the Highlands. The construction of the proposed project (including the wellfield, power plant, and transmission line) in the Highlands would be considered by the local tribes to have a significant, adverse effect on the spiritual and religious significance of the region. The impact of construction disturbance would be short-term and temporary; construction would last 33 months. Local tribal members consider the construction of the proposed project in the Medicine Lake Highlands as a significant adverse effect and believe that it would conflict with their religious use of the area (Pit River Nation 1996; Theodoratus et al 1998). The project would not deny access to ceremonial sites and would not deny the right to practice American Indian religions. The impact of construction is considered significant and unavoidable because the project would introduce visual and audible elements that would alter the setting in the vicinity of the project.

The effects of project noise and effects on the landscape views in the Medicine Lake Highlands are discussed in impact statements 4.6.3 and 4.6.6 below.

Operation: The proposed project facilities would represent visible, audible, and atmospheric alterations to the existing landscape through the introduction of the power plant, transmission line, and steam plumes, which would become a part of the landscape of the Medicine Lake Highlands (see impact statement 4.6.6 for effects on

views). Operation of the proposed project would result in increased noise levels in the forest. Operation of the proposed wellfield, power plant, and transmission line would be considered by local tribal members to have a significant adverse effect on the spiritual and religious significance of the Medicine Lake Highlands for the same reasons identified under construction effects on Medicine Lake Highlands. Operation of the project would not deny access to sites or the practice of religion, but would be considered a significant unavoidable effect in the area because it could affect established religious use of the area by local tribal members.

Decommissioning: The disturbance related to the decommissioning activities would represent a short-term significant adverse effect. The completion of decommissioning of the project would have a long-term beneficial effect on the spiritual and religious value of the Medicine Lake Highlands as it would remove the project facilities and restore the project area to pre-project condition. It is not known whether decommissioning would restore the spiritual values that could be lost during project construction and operation. The noise and visual impacts, however, would no longer occur after the project was removed. Noise and disturbance from decommissioning activities would be considered a significant, unavoidable effect.

Mitigation Measures

Mitigation was developed and defined throughout this EIS/EIR to reduce or eliminate the effects of project construction, operation, and decommissioning. All mitigation defined in the EIS/EIR is designed to avoid or reduce impacts on the cultural and natural environment that would be affected by the proposed project. Mitigation for decommissioning activities is described in subsequent impacts. Mitigation for project activities will be reviewed and the appropriate tribes, bands, and/or groups will be consulted.

As part of the project (if the project is approved), Calpine will provide at least 30 days notice to concerned tribes prior to beginning surface disturbing activities related to the construction activities for the proposed project (the BLM/USFS would notify the tribes and provide the Record of Decision for the project when a decision is made whether or not to approve the proposed project). The notice to the tribes will include the specific location, date of commencement, and expected schedule and duration of the project phases. The project schedule will be updated annually in April during the construction phase and submitted to the tribes to establish general project activities that would be conducted during the summer season. This notification may serve to reduce the potential for conflicts with tribal activities in the area.

Level of Significance After Mitigation

Significant Unavoidable.

4.6.2 Direct Effects on Traditional Sites in the Medicine Lake Highlands

The proposed project would not result in physical surface disturbance effects at any of the 34 sites identified (through tribal consultant interviews) as having traditional use or significance to American Indians. The transmission line segment A1 as proposed, was originally believed to cross a portion of the southern tip of one site identified by tribal members; however, the site was not located and the project would not cause physical

surface disturbance effects at the site. The effect would therefore not be significant. A mitigation measure was defined to avoid these effects by rerouting the transmission line. The mitigation measure will remain in the EIS/EIR in case the site is located in the future. The effect would be less than significant after mitigation.

Construction: As described in Section 3.6, Traditional Cultural Values, the interviews with tribal members resulted in the identification of 34 individual sites in the project region that have special meaning or significance to the tribes interviewed. The site names and locations are considered confidential and are identified by number only in this analysis (see above). The full extent of the sites and details of use have not been verified in the field, although the field work conducted by Theodoratus et al. (1998) did verify traditional use at all but two of the sites. The exact boundaries of the traditional-use sites were not determined in the field.

Construction of the wellfield, power plant, and freshwater pipeline are not expected to affect the physical integrity of the traditional-use sites identified through ethnographic research to date. No project-related surface disturbance would occur at any of the specific locations defined in the interviews with tribal consultants as a result of project construction. No sites are located within 0.25 miles of the wellfield and power plant area.

Construction of the proposed transmission line route is not expected to affect the physical integrity of the identified sites. No direct effects to these sites would occur due to project construction. The potential for significant impacts to Site #14 could exist if the site is located in the future. Construction of a transmission line pole in the site would be a significant effect. A mitigation measure is presented below to eliminate any physical surface disturbance at this site or other sites.

The proposed transmission line route would be within approximately 500 feet of two traditional-use sites (Site #12 and Site #13). The proposed transmission line could pass within approximately 0.5 miles of Site #7 and 1 mile of Site #8.

The proposed transmission line would be located approximately 0.25 to 0.50 miles from another traditional-use site (Site #25). The proposed transmission line would be one of several already in the area, but no project facilities would be located on this particular site. The proposed transmission line would not introduce elements that are out of character with the area around the site. Project construction would not affect the physical integrity of Site #25. The noise and visual effects on this site are addressed in impact statements 4.6.3 and 4.6.6 of this section.

Operation: Operation of the proposed project would not result in surface disturbance at any of the identified traditional sites in the Medicine Lake Highlands. Operation of the project would have no effect on the physical integrity of traditional use sites. The closest site to the proposed power plant and wellfield is Site #7, located about one mile southeast of the proposed plant site. Site #7 is approximately 500 feet from the proposed transmission line. In addition, four other traditional-use sites are located close to the proposed transmission line route: Sites #8, #12, #13, and #33. . These sites are less than 0.5 miles from the line. The effects of operation of the proposed project on the physical integrity of the identified sites would be less than significant.

Decommissioning: The decommissioning of the proposed project would have the same effects on the identified sites as would construction. The effect of decommissioning on Site #14 would be significant, if the site is located and would be affected, and if Mitigation Measure 4.6.2a was not implemented. If the mitigation measure is implemented, the effect of decommissioning would be less than significant.

Mitigation Measures

4.6.2a The proposed transmission line shall be rerouted to avoid traditional-use sites. The appropriate local tribes shall be consulted for location and areal extent of sites prior to the commencement of construction activities. (C)

Level of Significance After Mitigation

Less than Significant.

4.6.3 Effects of Project Noise on Traditional Sites and Uses

The proposed project would generate noise that could be audible at traditional-use sites (Theodoratus et al. 1998)). The noise effects of the project would be significant and adverse if they are audible at the sites and interfere with religious or ceremonial practices.

Construction: The construction of the proposed project may be audible at some of the traditional sites identified by tribal consultants. Construction noise would be generated by well pad, road, power plant, and transmission line construction. Well drilling and testing activities would also generate noise in the construction phase of the project and would result in the highest noise levels of construction. Construction noise sources and sound levels are discussed in Section 4.14, Noise, of this document.

Construction of facilities at the wellfield and power plant might result in noise levels that would alter the character of traditional sites and the surrounding areas. Construction and drilling noise levels would be highest at the traditional sites closest to the proposed wellfield and power plant. These include Sites #7, #8, #10, #12, and #13.

Noises that would be heard at these sites from the wellfield and power plant area would vary from clanging pipes during well drilling to rushing sounds. Sounds, generally, would be distant. Noise impacts would result from conductor pulling with a helicopter, which would cause higher noise levels in a wider area than other transmission line construction activities. Noise levels resulting from the transmission line construction are also described in Section 4.14, Noise.

The noise effects on identified sites and traditional uses cannot be specifically defined with the data gathered from tribal members to date. Traditional uses of sites in the project area were identified but the specific location, nature, and frequency of current use by tribal members is not fully understood. It is not known how existing activities (e.g., recreation, forest management) have affected traditional uses. Noise levels at the sites would be highest during certain construction activities; however, many sounds would be intermittent. The actual effect would depend on construction activities, their coincidence with traditional-site use, and individual tolerance of the noise.

Construction-related noise levels would be considered a short-term, significant adverse impact if the noise interfered with religious or ceremonial practices. Construction noise

impacts would be considered a short-term significant adverse effect if the noise altered the character of the site during tribal use, or caused tribal members to choose to not conduct traditional practices in the area because of the noise. The potential exists for significant impacts to sites and that the impact could not be avoided and could not be fully mitigated to levels below significance.

Operation: The operation of the proposed power plant would result in noise levels that could be audible at the sites closest to the project wellfield and power plant. The primary noise source would be the cooling tower fans and the sound of the water falling through the baffles of the cooling towers. The operation phase also would include noise from drilling wells, as described above under "Construction". Drilling and well testing activities would occur approximately once every two years and last for 30 to 120 days.

Transmission line maintenance also could result in increased noise levels at traditional sites on a short-term basis (see Section 4.14, Noise). Line maintenance could require the use of heavy equipment or other noise-generating sources.

Operational noise levels would result in a significant adverse impact if they interfered with religious or ceremonial practices or if they affected the spiritual nature of the area. Noise effects of operation would be considered a significant adverse effect if the noise altered the character of the site during tribal use, or caused tribal members to choose to not conduct traditional practices at the site. The effect is considered potentially significant due to the uncertainty as to whether the noise would be audible at the sites, would conflict with use of sites, or occur at the same time tribal members use the sites. The potential exists for significant impacts to sites and that the impact could not be avoided and could not be fully mitigated to levels below significance.

Decommissioning: The noise effects related to decommissioning would be similar to those of construction activities. Decommissioning-related noise levels would be a short-term significant adverse impact if they interfered with religious or ceremonial practices or if they affected the spiritual nature of the area. Decommissioning noise impacts would be considered a short-term significant adverse effect if the noise altered the character of the site during tribal use or caused tribal members to refrain from conducting traditional practices in the area.

Mitigation Measures

The noise controls identified in Section 4.14 shall be implemented to reduce noise levels, as feasible.

4.6.3a Calpine shall designate an authorized representative who may be contacted by tribal members during construction to determine activity schedules; this would reduce the potential for interference with tribal activities in the project area during construction. The Calpine representative's name and telephone number shall be provided during the annual project schedule update. (C, O, D)

4.6.3b Prior to the commencement of construction activities, Calpine and the USFS shall consult with the appropriate local tribes to determine which sites of tribal concern should be evaluated for noise effects. A monitoring program shall be defined that would determine actual project-related noise levels (with monitoring during drilling and power plant operation). Rescheduling certain

project activities and use of temporary noise shields to minimize effects also may be considered. (C, O)

Significance After Mitigation

Potentially Significant Unavoidable.

4.6.4 Effects on Access to Traditional Sites

The proposed project would not preclude access to traditional sites identified in interviews with tribal members conducted for the proposed project. The proposed project facilities would not be located in areas that are known to be used for traditional resource collecting or gathering or religious use, and thus would not prevent access to these types of sites. The project would not result in closing off areas to tribal use. The project would not affect American Indian access to sites used for traditional religious practices; the effect would be less than significant.

Construction: During project construction, the power plant site and the well pads would be fenced off and inaccessible for safety reasons. Transmission line construction could result in temporary restrictions in access around the immediate construction areas. These facilities would not be located in areas of identified traditional or religious practices.

None of the traditional sites identified by tribal consultants would be inaccessible during project construction. Mitigation is defined in measure 4.6.2a and 4.6.3b to avoid an affect on site #14, if it is located within an area of project effect. The construction would not result in a significant effect on tribal access to traditional sites.

Operation: Project operation and maintenance would preclude access to specific facility sites. Due to safety precautions, portions of the wellfield, such as fenced well pads and the power plant facility, would not be readily accessible. None of the locations of project facilities have been identified as locations of traditional use or religious practices. Sites identified as important by tribal members would be accessible. Project operation would have no effect on tribal access to traditional sites. There would be no significant impact on access to traditional sites due to project operation.

Decommissioning: Similar to the project construction phase, proposed project facilities may be fenced off and inaccessible during project decommissioning due to safety precautions. None of the sites identified by tribal consultants would be inaccessible during project decommissioning. Decommissioning activities could significantly affect a portion of Site #14, if it is located in an area of potential effect; the effect would be avoided if Mitigation Measure 4.6.2a is implemented.

Mitigation Measures

The project would not preclude access to traditional sites, so no additional mitigation measures are proposed. Mitigation Measure 4.6.2a would avoid direct effects to Site #14.

Significance After Mitigation

Less than Significant.

4.6.5 Effects on Traditional Religious Practices

Tribal members have expressed concern, in both tribal consultation meetings and interviews, that the proposed project could affect the tribes' traditional ceremonial and religious practices in the Medicine Lake Highlands because the project would affect the spiritual value of the Highlands. If the proposed project causes tribal members to choose to not conduct traditional religious practices, the project would have a significant adverse effect. The proposed project would therefore potentially result in an unavoidable significant impact.

Construction: During project construction, effects such as surface disturbance, noise, and visual impacts have the potential to affect local tribes' traditional ceremonial and religious practices in the Medicine Lake Highlands. Surface disturbance and construction activities would not occur within any identified traditional use site, but would occur in the Medicine Lake Highlands and on the Modoc Plateau. The tribes have stated that the spiritual value of the Highlands would be affected by the visual, audible, and olfactory effects that would result from project construction. It is not known if the construction activities would cause the tribes to choose to discontinue traditional religious, ceremonial, or other traditional-use activities at traditional use sites. The proposed project would not preclude access to traditional sites and would not deny the right to conduct religious practices in the area. If the project conflicted with tribal traditional or religious practices at sites, the effect would be significant.

Operation: Specific sites, and the Medicine Lake Highlands region as a whole, would be affected by the operation and maintenance of project facilities as a result of the industrial facilities location in the Highlands and the resulting views and noise created by the project. Noise and visual effects could result in significant adverse effects on the spiritual value of the Medicine Lake Highlands to tribal members. It is not known if the project operation would cause the tribes to choose to abandon or curtail traditional religious, ceremonial, or other traditional-use activities at traditional use sites. The proposed project would not preclude access to traditional sites and would not deny the right to conduct religious practices in the area. If the project conflicted with established religious practices at sites, the effect would be significant.

Decommissioning: Similar to the project construction phase of this project, decommissioning activities would not result in surface disturbance in any of the traditional use sites identified by tribal consultants. The spiritual value of the Highlands could be affected by the noise, visual, and other indirect effects that would be a result of project decommissioning. If the project decommissioning interfered with the ability of tribal members to conduct traditional practices in the Highlands, the effect would be significant.

Project decommissioning could restore the ability of the tribes to conduct traditional practices, if tribal members had chosen not to conduct activities due to operation of project facilities.

Mitigation Measures

All of the mitigation measures identified in this EIS/EIR would serve to reduce the effects of the project. Most mitigation measures would reduce the effects of project activities identified as a concern to tribal members. All of the mitigation measures

defined in this section 4.6 would serve to reduce the potential for interference with the tribes' ability to conduct traditional religious or ceremonial activities. Mitigation measures are also identified under Section 4.9, Visual Resources and Section 4.14, Noise.

Significance After Mitigation
Potentially Significant.

4.6.6 Effects on Landscape Views

The proposed project elements would be visible from many of the identified traditional sites, which include peaks in the Medicine Lake Highlands. The view of the project facilities would be considered a significant adverse effect because the project would represent an introduction of visual, audible, or atmospheric elements that are out of character with the property, or that alter its setting.

The effects of the proposed project on visual resources from Key Observation Points is described in Section 4.9, Visual Resources. Visual mitigation measures are also presented in Section 4.9. Section 3.9 describes the Key Observation Points and the visual setting and characteristics of the region. The analysis of the effect on landscape views presented here focuses on views from sites local tribal members have identified as important in traditional practices and beliefs.

Construction: The power plant would be located between Grouse Hill and Fourmile Hill (Figure 2.2-2); these two topographic features are expected to screen the view of the wellfield and the power plant site from most locations. The proposed transmission line would be visible from many locations in the Highlands, especially the Medicine Lake area.

Table 4.6-1 lists each of the traditional sites identified by tribal consultants and describes the elements of the project that would be visible during the day and at night from those sites. During construction, the project elements that would be visible from peaks surrounding the project area include:

- Drill rig masts
- Well testing steam plumes
- Cranes at the power plant site
- Transmission line tower erection
- Helicopters used during installation of transmission line conductors

Construction of the power plant area would be seen from Site #10 (foreground), and possibly from Site #6, Site #7, Site #9, Site #13, and Site #17 (middleground). The construction activities would last for approximately 33 months.

Construction of the transmission line would be visible from more sites than construction of the wellfield and power plant area. Transmission line construction would be of shorter duration and would progress along the line, with work crews operating in discreet areas (see Chapter 2, Section 2.2).

Construction views would introduce a view that is out of character with the setting and could affect the spirituality of the sites used by tribal members; these views could

Table 4.6-1: Project Facilities Visible from Sites Identified by Tribal Members

Site # [1] Identification	Probable Day Time Visibility to Project Features	Probable Night Time Visibility to Project Features
1	Background steam plumes from power plant	None
2	None	None
3	Background steam plumes from power plant	None
4	None	None
5	None	None
6	Middleground transmission line (Segment A1) power plant and well pad steam plumes Background transmission line (Segment A2)	None
7	Middleground transmission line (Segment A1) steam plumes from power plant and Wells	Middleground power plant lights well pads lights
8	None	None
9	Foreground transmission line (Segment A2) Middleground power plant power plant and well pad steam plumes transmission line (Segment A1)	Middleground power plant lights well pads lights
10	Foreground power plant and well pad steam plumes	Foreground power plant lights well pads lights
11	Middleground transmission line (Segment A1) Background steam plumes from power plant	None
12	Middleground transmission line (Segment A1) Background steam plumes from power plant	None
13	Foreground transmission line (Segment A1) Middleground steam plumes from power plant	None
14[1]	Foreground transmission line (Segment A1)	None
15	None	None
16	None	None

[1] Site #14 has not yet been located in the field by the ethnographic research team or the tribal consultants.

Table 4.6-1: Project Facilities Visible from Sites Identified by Tribal Members (continued)

Site # [1] Identification	Probable Day Time Visibility to Project Features	Probable Night Time Visibility to Project Features
17	Foreground transmission line (Segment A2) Middleground steam plumes from power plant	None
18	None	None
19	None	None
20	Middleground transmission line (Segments A1; A2) Background steam plumes from power plant and wells	None
21	Foreground transmission line (Segment A2)	None
22	Middleground transmission line (Segment A1)	
23	Foreground transmission line (Segments A2; A5, B1)	None
24	Middleground and Background transmission line (Segments A2; A5, B1) Background transmission line (Segment C1; C2)	None
25	Middleground transmission line (Segment C1) Background transmission line (Segments B1, B2, and C2)	None
26	Middleground and Background transmission line (Segment C1)	None

[1] Map identification numbers correspond to specific sites identified by tribal members. These site locations are confidential. The site numbers are keyed to the site numbers in Table 2 and map Figure 2 in Theodoratus and Emberson (1996).

SOURCE: 2M Associates 1997

conflict with traditional religious practices. The views of construction would be considered short-term, temporary significant impacts.

Operation: During project operation, portions of the transmission line and steam plumes from the wellfield and power plant area would be visible from many of the sites identified by tribal consultants (see Table 4.6-1). From three of the sites, Site #7, Site #9, and Site #10, lights from the wellfield and power plant would be seen at night.

The project would introduce industrial elements into the forest landscape. The effect of the project on landscape views could be considered a significant, long-term adverse effect if it conflicts with religious practices. The defined mitigation may not fully mitigate the effect; the impact would therefore be considered a significant unavoidable impact.

Decommissioning: Project decommissioning effects would be similar to those outlined above for project construction. Decommissioning activities in the wellfield and power plant area and along the transmission line would be visible from many of the sites identified by tribal consultants (see Table 4.6-1). Decommissioning would result in improved landscape views through removal of the project elements.

Mitigation Measures

Mitigation measures to reduce the visual effects of the project are defined in Section 4.9, Visual Resources.

Level of Significance After Mitigation

Significant Unavoidable.

4.6.7 Effects on Natural and Other Resources in the Project Region

Tribal members have expressed concern about potential project effects to water quality, archaeological and historic sites, vegetation, wildlife, and the potential for effects from pipeline ruptures and chemical contamination (health and safety issues). The effects of the project on all of the resources in the area are addressed in this EIS/EIR. The following discussion directs the reader to specific sections in this EIS/EIR that address topic-specific impacts of the proposed project and the alternatives to the proposed project. The impacts on natural and other resources would be less than significant after mitigation (with the exception of the potential for significant impact to the tribes discussed in 4.16, Socioeconomics).

Archaeological and Historic Sites: The archaeological and historic resources of the study area for the project and the identified alternatives are addressed in Section 3.5 and 4.5, Cultural Resources. The wellfield and power plant site construction would not affect any archaeological sites. Sites near the wellfield and power plant site would be flagged and their boundaries delineated to ensure this protection. Detailed surveys (Class III) would be completed prior to construction along the selected transmission line route and proposed access roads to identify and record sites that could be affected by the construction of the selected transmission line. Mitigation measures would be implemented to avoid or eliminate adverse effects on sites that could be affected by construction of the transmission line or the associated access roads.

Water Quality: The effects on water quality and quantity are addressed in Section 4.3, Hydrology. The proposed project (power plant and wellfield) would be located approximately 3 miles from Medicine Lake. No effects to Medicine Lake water quality or quantity are expected from the proposed project. No effects are expected on springs in the vicinity of Medicine Lake.

Vegetation: The existing vegetation in the area that could be affected by the proposed project and the alternatives are addressed in Section 3.7, Vegetation, of this EIS/EIR.

The effects to vegetation that would result from implementation of the proposed project or the alternatives are addressed in detail in Section 4.7, Vegetation. Mitigation measures have been proposed to reduce or eliminate effects to vegetation. The discussion below is a summary of information presented in Section 4.7.

The proposed project would result in effects to vegetation over a total of 388.5 acres. Approximately 174.3 acres of vegetation would be removed for project facilities. Vegetation would be converted on another 136 acres, and disturbed on approximately another 78.2 acres. Under CEQA, these effects to vegetation would be adverse, but would not be significant because of the amount of similar habitat in the vicinity. The vegetation removal, however, could represent a significant effect to the local tribes.

Vegetation in the immediate vicinity of the power plant would be affected by the deposition of geothermal condensate from the cooling tower. The effects to vegetation would be expected to be minor, and in the immediate vicinity of the power plant. The effects would not be significant because plant mortality would not result from cooling tower emissions.

Wildlife: Wildlife in the project area are described in Section 3.8 and effects to wildlife from the proposed project and alternatives are addressed in Section 4.8. The proposed project would affect wildlife habitat over the 388.5 acres that would be required for the proposed wellfield, power plant, access roads, and transmission line facilities. The effects of the proposed project after mitigation measures are implemented would be adverse, but would not be significant because mitigation would be implemented to reduce or eliminate effects.

Human Health and Safety: Concern has been expressed by tribal members about the potential for effects to resources from pipeline ruptures. Accident control measures are addressed in the description of the proposed project, Section 2.2, Chapter 2, in the EIS/EIR. The effects of potential pipe ruptures and spills are also addressed in Section 4.7, Vegetation, and Section 4.15, Human Health and Safety.

Tribal members also expressed concern about effects of chemical contamination. The chemicals that would be used in the proposed project are described in Chapter 2, Section 2.2 and in Chapter 4, Section 4.15, Human Health and Safety. No significant effects are expected to result from the proposed project since the chemicals used in the proposed project are generally not classified as hazardous. Hazardous materials would include oils, lubricants, diesel fuel, solvents, a biocide, and hydrogen peroxide in relatively small quantities (see Table 4.15-1).

Socioeconomics: The socioeconomic effects of the proposed project and the alternatives are addressed in Section 4.16. The local tribes would not receive any direct compensation as a result of the proposed project. Local tribes would not derive any economic benefit from the proposed project, other than the potential for employment. Calpine and its contractors have already expressed a willingness to consider tribal members for employment on project-related jobs, including project archaeological studies.

The preamble of AIRFA recognizes that the religious practices of Indian people are an "indispensable and irreplaceable" part of Indian culture. This Act was intended to

reaffirm Native American identities and cultures. Indian religions remain a central part of Indian cultures and native traditions. Indian religious beliefs are integrated with all other aspects of life. Particular places are seen as an integral part of native religious and cultural practices. The emphasis on "place" of religious practices is not separated from other cultural aspects, for example, social or political aspects of culture. Impact on a few practitioners may affect the Native group as a whole since practitioners are well known and their spiritual efforts are extended to the population as a whole.

This project could have a disproportionate effect on the American Indian community. The effect on local tribes is considered a significant unavoidable adverse impact due to the potential for the project to affect the spiritual nature of the area and the potential for tribal members to change their religious practices or use in the area.

Mitigation Measures

Mitigation measures designed to reduce the effects of the project (described above) on the natural and cultural environment can be found in this document under the appropriate section.

4.6.7a Prior to the commencement of project construction activities, Calpine shall make a specific outreach to local tribes for hiring for both construction and plant operation jobs. A similar outreach shall be made prior to decommissioning activities. (C, O, D)

Level of Significance After Mitigation

Less than significant.

4.6.8 Effects of Amending the Klamath National Forest Land and Resource Management Plan Standard 24-25

The Klamath National Forest LRMP standard 24-25 regarding protection of Native American values states:

> "Protect traditional Native American rights and practices (Public Law (PL) 95-341) to insure the integrity of the site and to assure that use will continue to occur and will not be impaired." (Standard 24-25)

The intent of this standard was to comply with the American Indian Religious Freedom Act (AIRFA), which states:

> "...the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian ... including but not limited to access to sites, use and possession of sacred objects, and freedom to worship through ceremonials and traditional rites." (PL 95-341; 42 USC 1978)

The USFS has conducted extensive consultations with the local tribes to identify tribal concerns about the proposed project and to protect Native American rights, also, the USFS has conducted several meetings with the tribes regarding the proposed project and the tribes have stated that they are opposed to the project (see section 3.6, Traditional Cultural Values).

In addition to meetings between the USFS and the tribes, the interdisciplinary EIS/EIR team ethnographer conducted 31 interviews with tribal members. The interviews were

conducted to identify traditional sites and uses in the project region, to understand Native American concerns about the proposed project, and to identify how the tribes would be affected by the project. The project has been designed and mitigation has been defined to minimize the effects of the proposed project on the environment and on the local tribes. The American Indian rights, including those to access sites and to conduct ceremonies, would not be affected by the proposed project.

Members of the consulted tribes have stated that the proposed project would affect the spirituality of the Medicine Lake Highlands and would affect their religious practices (Theodoratus et al. 1998). The proposed project would not preclude access to the Medicine Lake Highlands or specific traditional sites. The project would not prohibit tribal members from conducting traditional activities. However, elements of the project would be visible and audible at sites in the Medicine Lake Highlands. Tribal members may choose to not use sites in the project region and their use might be affected by sights, sounds, or smells of the project.

If tribal members choose to discontinue use of sites as a result of project-generated noise or changes in visible elements, the proposed project would be inconsistent with the current Klamath LRMP standard 24-25, as written. The project would, however, be consistent with the intent of the standard to comply with AIRFA and the protection of American Indian rights of freedom of religion.

This potential inconsistency with the standard (but not the intent of the standard) would not result in a physical change to the environment or result in a substantial alteration of planned land use. Should the proposed project be approved, this standard will be amended.

If tribal members' planned land use of the area changed as a result of the project, this would be considered significant under CEQA. Impacts to American Indians are considered significant.

Standard 24-25 is unenforceable as continued use of traditional sites can not be assured. The intent of the standard was to provide the protections specified under PL 95-341, but not to provide more rights than the law allows. The standard was written in error. One of the decisions that the Klamath National Forest will therefore consider along with the decision on whether to approve the proposed geothermal project, is whether to amend the LRMP to revise the above forest-wide standard #24-25 to reflect the protections provided under PL 95-341. The standard would be revised to state:

> "Protect traditional Native American cultural and religious uses and practices consistent with PL 95-341, American Indian Religious Freedom Act of 1978."

The amendment would make the Klamath National Forest LRMP consistent with PL 95-341 (AIRFA) and the Modoc Forest LRMP. The amendment would correct an unenforceable policy, the concept that the Klamath National Forest can require the Native American community to use an area. The Klamath National Forest would still provide protection under PL 95-341 that will protect the physical integrity of the site and not prevent access. While this amendment may be significant under CEQA because it could result in a conflict with an established religious use of an area (in this case the Klamath National Forest, although there are no identified religious use sites on the

Klamath Forest in the project area), it is a non-significant plan amendment and not significant under NEPA, which governs Federal actions. Because the standard was unenforceable, the amendment would not reduce the level of protection to tribal access or use.

Mitigation Measures
No mitigation is defined.

Significance After Mitigation
Significant Unavoidable.

ALTERNATIVES

The following discussion describes potential effects and recommended mitigation measures for each alternative to the proposed project. For Alternatives 2-6, potential impacts associated with the proposed wellfield and power plant would be the same as described for the proposed action (Alternative 1), since these facilities would be the same for all alternatives. Alternatives 2-6 would each use at least a portion of the proposed transmission line route, and descriptions of potential impacts along these portions of the transmission line are not repeated under each alternative discussion. The analysis of these impacts focuses on the effects that would be different from those identified for the proposed action.

Alternative 2 (Segments A1, A2, B1, and C2)

Alternative 2 differs from the proposed action by the substitution of transmission line segment C2 for segment C1 and two different potential locations for the substation (only one substation would be constructed) at the end of the transmission line. The effect of Alternative 2 on traditional cultural values would be similar to the proposed action, and the impacts of this alternative would remain significant. The substitution of segment C2 for C1 would result in the transmission line passing closer to one of the sites identified as important by tribal consultants, Site #26. Segment C2 would pass within approximately 500 feet of this site. However, this site would not be directly affected by any project activities, and similar to segment C1 it would be seen from two other traditional-use sites; Sites #24 and Site #25, but is much farther from Site #25. This alternative would be considered by the tribes to have greater effects to traditional cultural values as it would still include segment A1, which would be visible from Site #12, and would pass close to Site #26 along segment C2 (segment C1 of the proposed action would end near Tionesta, rather than near Site #26 located farther north). Any human remains or other cultural objects discovered along segment C2 would be treated according to the Native American Graves Protection and Repatriation Act (NAGPRA) and Section 106 of the NHPA. Please see Section 4.5, Cultural Resources, of this document for more information on NAGPRA, the Section 106 process, and mitigation.

The mitigation measures described for the proposed action would apply to this alternative. The impacts after mitigation would be significant and unavoidable.

Alternative 3 (Segments A1, B2, and C1)

Alternative 3 differs from the proposed action by the substitution of transmission line segment B2 for segments A2 and B1. This transmission line route extends south of Site

#20 and Site #21 located south of Glass Mountain before heading north to connect with segment C1. The effect of Alternative 3 on traditional cultural values would be very similar to the proposed action and would include segment A1, which would be located in the Medicine Lake area. This alternative would not avoid any significant effects. Segment B2 would pass closely by sites located south of Glass Mountain (Sites #18, #20, #21), but the distance would be farther than 0.25 miles. These sites would not be directly affected by the use of segment B2. Segment B2 would be visible in the background of vistas seen from Site #25 located near Tionesta.

The mitigation measures described for the proposed action would apply to this alternative. The impacts after mitigation would be significant and unavoidable.

Alternative 4 (Segments A1, B2, and C2)

Under Alternative 4, segment B2 would replace segments A2 and B1, and segment C2 would replace segment C1. Alternative 4 is the same as Alternative 3 except that the transmission line follows segment C2 north to avoid Tionesta, rather than following segment C1; C2 is closer to Site #26, but farther from Site #25. The effect of Alternative 4 on traditional cultural values would be similar to the proposed action. Alternatives 2 and 3 outline how the use of segments B2 and C2, respectively, would affect the project area. This alternative would not avoid any significant effects.

The mitigation measures described for the proposed action would apply to this alternative. The impacts after mitigation would be significant and unavoidable.

Alternative 5 (Segments A3, B1, C1)

Alternative 5 differs from the proposed action by the substitution of transmission line segment A3 for segments A1 and A2. Segment A3 extends north from the power plant, passing to the west of Fourmile Hill, and then passes within less than 500 feet of Fourmile Hill. Segment A3 then extends east, following a route to the north of Mt. Hoffman.

The tribes consulted for the project are in agreement that the proposed project should not be approved because it severely impacts a documented sacred/traditional area of northeast California tribes. However, in interviews conducted by Theodoratus (Theodoratus et al. 1998), tribal consultants expressed a preference for a transmission line route that avoided the Medicine Lake area and indicated that route C1 (to Tionesta) was preferable to route C2 (to the Dry Lake area). Comments received on the Draft EIS/EIR from a Pit River tribal member, however, indicated that the northern route is not desirable because of the proximity to other traditional use sites. Alternative 5 would be considered to have the least effect on local tribal use of the area as it avoids the Medicine Lake area that would be affected under Alternatives 1, 2, 3, and 4. This alternative would avoid the potential for effects at Site #14 (if this site is located in the future), would avoid the areas of Site #26, and would be within 0.5 miles of Site #25. This alternative would not avoid the significant effects identified for the proposed action.

The mitigation measures described for the proposed action would apply to this alternative. The impacts after mitigation would be significant and unavoidable.

Alternative 6 (Segments A3, B1, and C2)

Under Alternative 6, segment A3 would replace segments A1 and A2, and segment C2 would replace segment C1. Alternative 6 is the same as Alternative 5 except that it follows segment C2 north to avoid Tionesta, rather than following segment C1. The effects of Alternative 6 on traditional cultural values would be less than those alternatives that pass between Medicine Lake and the Medicine Lake Lava Flow (see discussion under Alternative 5); however, this route would pass through the area of Site #26 along segment C2, which is not preferable to the tribes interviewed. The significant effects identified for Alternative 1 would still occur under this alternative.

The mitigation measures described for the proposed action would apply to this alternative. The impacts after mitigation would be significant and unavoidable.

Alternative 7

Traditional cultural values would not be affected by the implementation of Alternative 7, the No Action alternative. No mitigation measures would apply to this alternative.

4.7 Vegetation

REGULATORY FRAMEWORK

Federal and State Endangered Species Acts

The Federal Endangered Species Act (FESA) and the California Endangered Species Act (CESA) provide the general framework for the protection of endangered and threatened plant species. Formal consultation with the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (CDFG) is required for those projects that would affect listed plant species. A detailed description of the regulatory framework for the protection of special status species is contained in the Regulatory Framework discussion in Section 4.8, Wildlife.

California Natural Diversity Data Base

In order to inventory special status species in California, the CDFG has established the California Natural Diversity Data Base (CNDDB), a program that lists the state's natural vegetation communities and "special plants." CNDDB special plants include state and Federally listed, proposed, and candidate species and taxa that the CDFG considers to be rare, very restricted in distribution, declining, or closely associated with a habitat that is declining at an alarming rate in California. Species that are identified as sensitive by other government agencies (e.g., the BLM and USFS) are also considered to be CNDDB special plants.

California Native Plant Society

The California Native Plant Society (CNPS) publishes and regularly updates the *Inventory of Rare and Endangered Vascular Plants of California*, (Skinner and Pavlik 1994) which has become a standard reference on California's rare and endangered plants. The CDFG recognizes that Lists 1A, 1B, and 2 of the *Inventory* contain plants that, in a majority of cases, would qualify for listing, and the CDFG will request their inclusion in environmental documents as necessary. Species classified as lists 3 or 4 are plants that are considered to be of lower sensitivity and do not fall under Federal or state regulatory authority.

Forest Service Sensitive Plant Program

The USFS has established the Forest Service Sensitive Plant Program as a means to maintain viable populations of all native plant species in habitats occurring on USFS lands, develop and implement management practices to ensure that species do not become threatened or endangered because of USFS actions, to develop and implement management objectives for populations and habitat of sensitive species, and to assist states in achieving their goals for the conservation of endemic species. The USFS uses the term "sensitive" to refer to plant species occurring on USFS lands that are considered valid candidates for Federal threatened or endangered listing under FESA (Stewart 1994).

Northwest Forest Plan

The Northwest Forest Plan provides guidance for protection of late seral stage-associated species. The guidelines for the protection of these species are currently being

developed, but those species listed as Category 2, "survey and manage" will be protected as if they are sensitive species (Sanger 1996, pers. com.; USFS and BLM 1994).

California Environmental Quality Act

The California Environmental Quality Act (CEQA) also provides protection for rare and endangered plant species, regardless of whether they are formally listed. Typically, those species meeting criteria for consideration under CEQA include any listed, proposed, or candidate plants, CNPS List 1A, 1B, and List 2 species. CNPS List 3 and 4 and USFS Special Interest species do not meet the criteria for consideration under CEQA. CEQA encourages informal consultation for Federal candidate species that may become officially listed prior to completion of the CEQA process.

KEY ISSUES

The key vegetation issues identified and evaluated in this section relate to the effects of the project on vegetation (removal of), special-status plant species, and old growth forests (late seral areas). These effects are evaluated in Impacts 4.7.1, 4.7.3, and 4.7.4.

SIGNIFICANCE CRITERIA

Federal and state endangered species laws require protection of listed endangered or threatened plant species. Federal and state lists of threatened and endangered species, USFWS lists of species of concern, the CDFG CNDDB list, CNPS's *Inventory of Rare and Endangered Vascular Plants of California*, and the Forest Service Sensitive plant lists identify special status species. CEQA also provides protection for rare and endangered plant species regardless of whether they are formally listed. In addition, USFS policy is to protect "sensitive" and "special interest" species as part of its overall policy to protect all native plant species.

Section 15065(a) of the CEQA Guidelines specifies that a lead agency shall find that a project may have a significant effect on the environment when the project has the potential to substantially reduce the number or restrict the range of a rare or endangered species, or threaten to eliminate a natural plant community. Appendix G of the CEQA Guidelines states that a project would normally have a significant effect on the environment if it would substantially affect a rare or endangered species of plant or the habitat of the species or would substantially diminish habitat for plants.

Section 15380 of the CEQA Guidelines further defines "rare or endangered species" as those species officially listed as threatened, endangered, or rare under Federal or California law. In addition, the Guidelines provide that plant species may be treated as "rare or endangered" even if not on one of the official lists if:

- The survival and reproduction of the species in the wild are in immediate jeopardy
- The species exists in such small numbers throughout all or a significant portion of its range that it may become endangered if its environment worsens
- The species is likely to become endangered in the foreseeable future and may be categorized as "threatened" under Federal law

Species would also be considered rare and endangered if listed as a sensitive species by the USFS.

PROPOSED ACTION (ALTERNATIVE 1)

4.7.1 Effects on General Vegetation

Construction of the proposed project would affect approximately 388.5 acres of general vegetation (see Table 4.7-1). Approximately 174.3 acres of this total would be loss of vegetation due to removal and clearance of vegetation at the power plant and wellfield and along the transmission line. This impact would not be significant because most of the affected vegetation types are common and widespread in the area, and there would not be a significant reduction in this vegetation. However, effects to late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches would be significant, and mitigation is identified. Operation and decommissioning of the project would be expected to cause minimal additional effects to vegetation, which would not be considered significant.

Construction: Table 4.7-1 shows the amount of general vegetation that would be affected by the proposed project, according to vegetation community type. Effects to general vegetation are organized into four categories:

- **Removal:** Removal would involve complete removal of vegetation, with no revegetation expected to occur during the lifespan of the proposed project.
- **Removal-Conversion:** The removal-conversion category would include areas where one type of vegetation (such as forest) is removed and replanted with a different type of vegetation (such as grass and/or shrub seed mix).
- **Disturbance:** The disturbance category includes areas where vegetation is disturbed by activities such as tree topping, but stays essentially the same (i.e., existing vegetation is not cleared, and conversion does not occur).
- **No Disturbance:** Areas that are categorized as "no disturbance" would generally not require any vegetation removal or modification.

Estimated vegetation disturbance along the transmission line was calculated in two steps. First, the transmission line was divided into three main sections: the Medicine Lake Highlands, Transition, and the Modoc Plateau. The Medicine Lake Highlands extend from the start of the transmission line at the proposed power plant site to the Siskiyou/Modoc county line. The Transition area extends from the Siskiyou/Modoc county line to the COTP line. The Modoc Plateau extends from the COTP line to the eastern end of the transmission line.

Next, estimates of construction activities necessary to construct the transmission line were made for each section. Estimates for the Medicine Lake Highlands included the following:

- The Highlands are primarily forested with early to mid-seral size trees
- 100 feet of vegetation would be cleared, with 12.5 feet on each side topped
- All new transmission line access roads in this area would be bladed

Similar to the Medicine Lake Highlands section, the Transition section is primarily forested. However, trees in the Transition section are not as large as those found in the Medicine Lake Highlands. A 50-foot-wide corridor would be cleared in this section, and 37.5 feet on each side of the clearance would be topped. Similar to the Medicine Lake

Table 4.7-1: Habitat Loss and Disturbance Associated with the Proposed Project (in acres)

	RFF[1]	UMMC	LPF	MEAD	HERB	ROCK	DIST	LMMC	PPF	PPP	BIG	RAB	JUN	AG	Total
Power Plant and Wellfield[2]															
Removed	1.0	21.0	24.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.7
Removed-converted	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disturbed	0.0	1.0	1.3	0.0	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
Subtotal	1.0	22.0	26.0	0.0	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.7
Transmission Line															
Removed	7.9	21.5	47.4	0.7	0.8	0.0	0.5	8.7	9.1	8.6	5.1	7.0	10.2	0.0	127.5
Removed-converted	9.9	31.8	72.1	0.9	1.3	0.0	0.3	6.5	6.7	3.9	0.0	2.6	0.0	0.0	136.0
Disturbed	2.9	9.4	21.1	0.7	0.4	0.0	0.5	10.4	10.8	7.9	2.4	5.3	3.5	0.0	75.3
Subtotal	20.7	62.7	140.6	2.3	2.5	0.0	1.3	25.6	26.6	20.4	7.5	14.9	13.7	0.0	338.8
TOTAL[3]	**21.7**	**84.7**	**166.6**	**2.3**	**2.8**	**0.4**	**1.3**	**25.6**	**26.6**	**20.4**	**7.5**	**14.9**	**13.7**	**0.0**	**388.5**

Notes:

[1] RFF = Red Fir Forest; UMMC = Upper Montane Mixed Conifer Forest; LPF = Lodgepole Pine Forest; MEAD = Meadow; HERB = Herbaceous; ROCK = Rock outcropping; DIST = Disturbed; LMMC = Lower Montane Mixed Conifer Forest; PPF = Ponderosa Pine Forest; PPP = Ponderosa Pine Plantation; BIG = Big Sagebrush; RAB = Rabbitbrush Sage; JUN = Juniper Woodland; AG = Agricultural

[2] For the purposes of this analysis, the establishment of the proposed wellfield and power plant would be considered a permanent loss of vegetation. Vegetation lost or disturbed by laying of the freshwater pipeline would be considered a temporary loss of vegetation because the line would be removed after the first season of drilling.

[3] Acreages may not total due to rounding.

SOURCE: Leitner 1997

Highlands section, all new transmission line access roads in the Transition section would be bladed.

The Modoc Plateau section is different than the Medicine Lake Highlands and Transition sections in that it is primarily shrubland. On the Modoc Plateau, vegetation clearance would be limited to transmission structure sites and bladed access roads. Occasional dispersed trees that are directly in the route of the transmission line conductors may also need to be topped or removed. Section 2.2 provides additional information on disturbance figures and vegetation clearance activities that would be required for the proposed project.

Based on the estimates of areas affected by construction identified in Table 4.7-1, construction of project facilities would affect approximately 388.5 acres of general vegetation. Approximately 49.7 acres of general vegetation would be affected at the wellfield and power plant (including the freshwater pipeline), approximately 335.8 acres of general vegetation would be affected by construction of the proposed transmission line, and about 3.0 acres of general vegetation would be affected at the proposed substation site. Lodgepole pine forest accounts for the greatest amount of vegetation that would be affected at about 40 percent of the total for the project area. Upper montane mixed conifer forest accounts for about 20 percent and northern juniper woodland about 13 percent of total affected vegetation, while the remaining affected general vegetation would be distributed across the remaining vegetation community types.

At the power plant and wellfield area, about 46.7 acres of general vegetation would be removed, which would be considered a loss of vegetation. About 1.0 acre of habitat loss at the power plant and wellfield area would consist of late seral stage red fir forest, the result of pipeline and access road construction. Approximately 24.7 acres would be lodgepole pine forest, and about 21.0 acres would be upper montane mixed conifer forest that has been logged in recent decades.

In addition to effects to general vegetation loss at the power plant and wellfield area, approximately 3.0 acres of vegetation would be disturbed by installation of the temporary freshwater pipeline. This pipeline would be laid by hand, and the 4-inch-diameter aluminum pipeline segments would be hand-carried to the pipeline route from a trailer along the adjacent road. The segments would be joined using appropriate hand tools, and the pipeline would be routed around trees, large rocks, and other surface obstacles. About 1.3 acres of disturbance from implementation of the temporary pipeline would occur in lodgepole pine forest, 1.0 acre would occur in upper montane mixed conifer forest, and 0.7 acre would occur in areas of herbaceous vegetation and rock outcroppings. This disturbance would occur only for the first year of the construction phase, at the end of which the pipeline would be removed. Neither vegetation clearance nor grading would be required within the pipeline route. This disturbance would not be considered a loss of general vegetation.

Construction of the transmission line would have the greatest effect on lodgepole pine forest and upper montane mixed conifer forest. Along the transmission line corridor, about 124.5 acres of general vegetation would be removed, which would be considered a loss of vegetation. Approximately 136.0 acres of vegetation would be converted from

one vegetation type to another, such as conversion of forest or woodland habitat to shrub or herbaceous cover. This change would not be considered a loss of general vegetation. Approximately 75.3 acres of vegetation would require the topping of trees for transmission line construction; these areas would be disturbed, but would not be removed or converted, and would therefore not be considered a loss of general vegetation. Construction of the proposed substation would result in the loss of about 3.0 acres of general vegetation.

The total vegetation loss of 174.2 acres associated with construction of the proposed action would not be a significant adverse impact of the project because vegetation loss would almost entirely affect vegetation communities that are common and widespread in the region. The proposed action would primarily affect lodgepole pine forest and upper montane mixed conifer forest, which are common and widespread habitat types in the region. In addition, four of the wellpad sites in the wellfield area are located on old log decks, and much of the remaining vegetation that would be cleared has been disturbed by timber harvest in recent decades. Minimal clearance would be conducted for constructing project facilities in the wellfield and power plant area. All timber removal within the power plant and wellfield area and along the transmission line route would be carried out in accordance with USFS specifications; felled trees and associated woody debris would be left in place for wildlife habitat or sold, as specified by the USFS.

Although the overall effect on general vegetation would not be significant, the proposed transmission line does have the potential to affect isolated stands of late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches. These vegetative features are considered to be of importance primarily due to their value as potential habitat for special-status wildlife species (see Section 4.8, Wildlife). These sensitive features are dispersed throughout the Forest, including the vicinity of the transmission line. The acreage of these features that would be affected would depend on the actual alignment of the transmission line. Construction of the transmission line would be expected to result in unavoidable effects to late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches even with mitigation designed to avoid these features, and additional mitigation is identified to compensate for these effects and reduce the effect of the project to less-than-significant levels.

Operation: During operation of the project, a minor amount of general vegetation loss or disturbance may occur as a result of surface disturbance associated with maintenance of the wellfield and power plant area, freshwater pipeline, access roads, wellpads, and transmission line. Within the wellfield and power plant area, maintenance around project facilities would affect a limited area of general vegetation. Along the freshwater pipelines, access roads, and the transmission line, the location of general vegetation affected by project maintenance would be dependent on the type of maintenance required. However, maintenance activities are expected to be limited along these facilities, and would generally only affect areas that had been previously disturbed during construction. The effect on general vegetation during project operation would therefore be considered less than significant. The potential depositional effects on

vegetation in the project area during project operation are discussed in impact 4.7.2 in this section.

Decommissioning: During the decommissioning of the proposed action, structures and facilities would be dismantled and removed from the area. Project decommissioning would require the use of the same areas previously used during project construction, and only areas that have revegetated may be disturbed by these activities. Decommissioning would therefore not be expected to significantly affect general vegetation.

After all project structures and facilities are removed, these areas would be scarified and replanted with a mix of vegetation similar to the vegetation that existed in the disturbed areas prior to project implementation. All revegetation efforts would be conducted in accordance with a revegetation plan, prepared under the direction of the USFS. The ultimate effect after revegetation would be to restore general vegetation previously lost or degraded in quality to essentially pre-project conditions. The proposed action, after decommissioning, would therefore not be expected to significantly affect general vegetation in the project area.

Mitigation Measures

Effects to general vegetation would be considered less than significant prior to mitigation, except for potential effects to late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches. Mitigation Measures 4.7.1a and 4.7.1b are identified to reduce effects to late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches to less-than-significant levels. Mitigation Measures 4.7.1c and 4.7.1d are recommended to further reduce the less-than-significant effects to general vegetation.

4.7.1a Vegetation loss shall be kept to a minimum during the construction of the project. Facilities shall be sited in areas of previous disturbance, such as log decks, wherever possible. During all construction, tree removal shall be kept to a minimum; removal of trees with a dbh greater than or equal to 18 inches shall also be minimized. The impact to late seral stage forest shall be minimized by skirting stands of forest, such as red fir, to the greatest extent possible. In addition, the freshwater pipeline shall be placed between trees, and shall avoid the need to clear timber. (C)

4.7.1b For loss of late seral stage forest and trees and snags with a dbh greater than or equal to 18 inches, Calpine shall be responsible for providing compensation since this loss will result in loss of habitat for certain special-status wildlife species. Compensation shall be provided as discussed under impact 4.8.1 in Section 4.8—Wildlife. (C)

4.7.1c Roads and wellpads shall be sited to minimize cut and fill and fill slopes shall be constructed at no greater slope than 1.5:1. Standard erosion control measures shall be implemented where appropriate, such as construction of water bars on roads, and check dams and energy dissipaters as needed. (C)

4.7.1d During construction of wellpads, the top 6 inches of surface soil shall be stockpiled separately for application onto the fill slopes. Following construction and decommissioning, a revegetation plan shall be prepared for the revegetation of the transmission line, wellpads, pipelines, and power plant site, under the direction of the USFS. The revegetation plan shall include the use of currently accepted practices and plant materials. Areas cleared within the transmission line right-of way shall be seeded or planted with native perennial grasses and low growing shrubs such as ceanothus, manzanita, and bitter brush. The selection of plant materials will be based on

site conditions and will approximate the species composition of nearby successional areas. (C, D)

Level of Significance After Mitigation

Less than significant.

4.7.2 Depositional Effects on Vegetation

Depositional effects on vegetation would primarily occur during the operation phase of the proposed action from air emissions from the proposed power plant. Depositional effects on vegetation could also occur from well venting and vehicle travel during construction and operation of the project, and from vehicle travel during decommissioning of the project. These effects would be considered less than significant.

Construction: Depositional effects are impacts caused by the deposition of particles or droplets on vegetation. In sufficient quantities, this deposition may have an adverse effect on the health of vegetation. In extreme cases, depositional effects can result in vegetation mortality. However, depositional effects are usually temporary since environmental factors (such as rainfall and wind) serve to cleanse vegetation of deposited particles or droplets on a regular basis. These environmental factors can prevent adverse effects from occurring to vegetation due to deposition of particles or droplets.

During project construction, dust may accumulate on vegetation adjacent to heavily used unpaved roads from vehicle travel on these roads. Such accumulations are sometimes associated with increased levels of plant pathogens. However, these accumulations are expected to be temporary due to the frequent removal of deposited particles by environmental factors, and no plant mortality is expected. This type of depositional effect during construction would therefore not be considered significant.

Well venting would result in deposition of geothermal steam condensate on vegetation adjacent to wellpads, although most deposition of droplets would occur actually on the wellpad (which would be cleared of vegetation). Effects to vegetation from deposition would be short-term and would not be expected to cause significant stress or damage to vegetation (see discussion under Operation). Some very localized damage to foliage on trees and plants immediately adjacent to the wellpads may occur, but this damage would not be expected to affect the overall health of this vegetation. The effect would be adverse and may be significant.

Operation: Depositional effects on vegetation during project operation would occur as a result of air emissions and moisture emitted from the cooling tower at the proposed power plant, and from well venting and vehicle travel. As discussed above for construction, potential depositional effects from dust from vehicle travel on unpaved roads during operation would not be considered significant. Potential depositional effects on vegetation from cooling tower emissions are described below; effects on vegetation from well venting would be similar. The potential depositional effects on vegetation during project operation is based primarily on the estimates of projected cooling tower emissions presented in Section 3.13, Air Quality, and on meteorological data collected at the proposed power plant site (T&B Systems 1996).

Cooling tower emissions are composed of gases and droplets of circulating water (or "drift") that is entrained in the airstream exiting the cooling tower. Drift contains some dissolved solids and is composed of a range of droplet diameters. The smallest droplets may evaporate, and the dissolved and suspended solids they contain form aerosol particles that remain suspended in the air, dispersing over a wide area. The largest droplets usually fall to the ground in the immediate vicinity of the cooling tower.

Characteristics of the power plant, such as the chemical composition and concentration of dissolved solids and the design of the cooling towers, determine how much and what kind of drift is emitted from a cooling tower. Local weather conditions, including wind, temperature, and relative humidity, determine how much of the drift becomes aerosol and how and where the remaining drift is deposited. Vegetation in the vicinity of cooling towers may be affected because plants readily absorb many kinds of dissolved solids applied to the leaf surface. The quantity of drift deposited on the leaf surface, and the amount and type of dissolved solids it contains determine the extent to which vegetation may be affected by deposition.

For the proposed project, the largest components of power plant emissions would be carbon dioxide (CO_2), nitrogen, hydrogen sulfide (H_2S), and ammonia. These emissions would be emitted primarily in gaseous form. CO_2 is essential for plant photosynthesis, and is taken up readily by plants. Nitrogen is inert with respect to plants.

H_2S and ammonia can serve as nutrient sources to vegetation if present in beneficial concentrations. Fumigation experiments have shown that test plants exposed to 0.5 to 1 parts per million (ppm) of H_2S were beneficial (Coyne and Bingham 1978), although higher concentrations could be toxic (McCallan et al. 1936). Air quality standards for H_2S are in the low parts per billion range, about two orders of magnitude lower than the concentration beneficial to plants. The proposed project would be expected to conform with applicable H_2S standards, and projected H_2S gas emissions would have no effect on nearby vegetation.

Fumigation experiments with ammonia have shown that the threshold for damage to plants is in the range of 3 to 12 ppm for 4 hours (Benedict and Breen 1955). Ammonia emissions at the proposed project are projected to be roughly similar to that of hydrogen sulfide (i.e., more than one order of magnitude below 1 ppm). These concentrations would therefore not be expected to have an adverse effect on plants.

Of the emission from the cooling tower present as dissolved solids, boron would be one of the most abundant and is of the greatest concern. Although boron is an essential plant nutrient, it is toxic to plants at higher levels. Boron has been implicated as the agent of plant stress and damage in the vicinity of older operating power plants at The Geysers that have higher boron emissions than those expected for the proposed project (Malloch et al. 1979). None of the other dissolved or suspended solid components in the circulating water would be emitted at rates that may cause harm to local vegetation.

In order to determine potential depositional effects on vegetation from boron emissions, a simple model has been used to develop estimates of the expected depositional rate of boron. This model assumes that all of the cooling tower drift is released from a single cooling tower stack. Because the proposed cooling tower would be a 10-cell unit, the drift emissions would actually be more dispersed at the release points than this simple

model implies. Therefore, actual boron deposition rates would most likely be less than the estimated rates. In addition, emissions would be directed away from vegetation to the greatest extent possible, which would further minimize the potential for cooling tower drift to affect vegetation.

To estimate the maximum boron deposition that may occur, several factors were considered:

- The total quantity of boron emissions
- The behavior of droplets in the stream of air exiting the cooling tower
- Meteorological data from the power plant site

The estimated emission rate for boron from the cooling tower at the proposed power plant would be 0.0261 lb per day, or 8.25 lb per year. Actual drift tests of cooling towers with high-efficiency eliminators indicates that about half the drift mass is in droplets large enough to become deposited as drift rather than becoming aerosol (Suder 1996). Therefore, one-half of the boron emissions may be considered to be deposited in the drift. Using one year of meteorological data from the power plant site (T&B Systems 1996), the most frequent wind direction is south-southwest, which prevails 10.4 percent of the time. Wind speeds are in the range of 2.0 to 3.9 meters per second about 65 percent of the time, These factors result in maximum deposition of large drift droplets within 50 to 100 meters of the cooling tower (Suder 1996).

The maximum boron deposition can be determined by multiplying the total boron emission of 8.25 lb per year by one-half to obtain the amount likely to fall as drift. This amount is then multiplied by the frequency of occurrence of this wind speed and direction (the area where the most deposition is projected to occur), and then divided by the acreage encompassed in this 22.5 degree (one-sixteenth of a circle) sector. Based on these calculations, the maximum boron deposition would be about 1.43 lb per acre per year for the area within 100 meters of the cooling towers.

The maximum boron deposition for the proposed project is calculated to be comparable or somewhat less than the maximum measured deposition at The Geysers Unit 13, a relatively modern power plant with emission levels similar to the proposed project. Although elevated concentrations of boron were found in plant tissues near the cooling towers, no visible symptoms of boron toxicity were found, and the leaves of mixed conifer forest surrounding the power plant unit did not exhibit symptoms of boron toxicity. A similar pattern of increased concentrations of boron is expected to occur in the leaf tissue of vegetation near the proposed power plant site. Although conifers in the vicinity of the power plant may accumulate boron to some extent, the levels would not be expected to affect the health of these species, and no visible effects to this vegetation are expected. Deposition of boron is therefore not likely to cause acute stress or damage to any vegetation in the project vicinity, and this effect would be less than significant.

In addition to air emissions, the cooling towers at the proposed power plant would emit moisture. It is possible that the increased humidity and moisture associated with the cooling tower emissions could result in vegetation damage in the immediate vicinity of the cooling towers. The increased warmth and humidity could create a more favorable

environment for pathogens, which could result in vegetation damage. Vegetation damage attributed to increased relative humidity has been observed in the vicinity of operating geothermal units at The Geysers (Jones and Stokes 1984). If this effect were to occur, it would be expected to be limited to the immediate vicinity of the power plant site. While adverse, this impact would be limited and insignificant.

An additional effect related to increased air moisture would be the potential damage of tree limbs due to accumulated ice during the winter months. Moisture from the cooling tower may accumulate as ice on nearby vegetation, causing breakage of limbs. This potential effect is expected to be localized near the proposed cooling towers if it occurs. While adverse, this impact would be limited and insignificant.

Decommissioning: Potential depositional effects upon vegetation during decommissioning would occur from dust from vehicle travel on unpaved roads. As discussed above for construction, these potential depositional effects would not be considered significant.

Mitigation Measures

Although the expected deposition effects of the proposed project on vegetation would be less than significant, the following mitigation measure is recommended to reduce or eliminate any adverse effect on vegetation from project emissions:

4.7.2a Calpine shall develop and implement a monitoring plan in coordination with the USFS to document the deposition impacts to vegetation in the vicinity of the power plant resulting from project operation. The plan shall include the following:

- Periodic (i.e., quarterly) chemical analysis of circulating water to ascertain the concentration of boron, mercury, and arsenic.
- An annual evaluation of the effect of cooling tower drift on nearby trees in the vicinity of the power plant. Assessment may be a semi-quantitative assessment of leaf damage, but may also include chemical analysis of damaged leaves.
- If tree mortality occurs in close proximity to the power plant site and it is determined that this mortality is due to the emissions of and deposition from the proposed project, revegetation shall be carried out by Calpine (as directed by the USFS) to compensate for these effects. This compensation could involve replanting more tolerant indigenous vegetation such as grass and shrubs in the power plant vicinity, providing off-site replacement vegetation, and/or enhancing other vegetated areas as directed by the USFS. (O)

Level of Significance After Mitigation

Less than significant.

4.7.3 Effects on Special-Status Plant Species

The proposed action could result in the loss of several populations of known special-status plant species in the wellfield and power plant development area during the construction, operation and decommissioning phases. Impacts to special-status plants would not be considered significant, and mitigation measures are identified to avoid sensitive plant resources that may occur in the area.

Construction: The proposed action may result in the loss of a population of Hall's sedge and several colonies of sugar stick in the wellfield and power plant area, and

several populations of gray penstemon and volcanic daisy on segment C1. Due to the limited amount of these special-status plant species that would be affected, construction of the proposed action would not be expected to eliminate or substantially reduce the number of these plant species, or substantially restrict the range or diminish habitat for these species. This impact would therefore not be considered a significant effect.

Potentially suitable habitat for several special-status plant species exists within the proposed transmission line corridor. Potential habitat for sugar stick and California pinefoot exists in forested areas, potential habitat for ash penstemon exists in meadow areas, and potential habitat for Baker's globe-mallow and tall woolly marbles exists along segment C1. Potential effects to these special-status plants may be significant if they are present along the transmission line corridor and are not avoided.

The false truffle is a special-status fungus likely to be found in late seral forests in the project area, particularly within the wellfield and power plant area. These and other fungus and lichen species mentioned in the Northwest Forest Plan may be impacted, although these potential impacts are not considered significant.

Operation: Operation of the wellfield and transmission line would not affect additional habitat beyond that affected by construction. Therefore, no operational effects to special-status plants are expected. Any maintenance plans would include maps of special status species in order to avoid these species during maintenance or emergency activities.

Decommissioning: Decommissioning of the wellfield and transmission line would not affect additional habitat beyond that affected by construction. Therefore, no decommissioning effects to special-status plants are expected.

Mitigation Measures

The following mitigation measures are recommended to ensure that any special-status plant species present in potential habitat along the transmission line would not be significantly affected by the project:

4.7.3a Early summer floristic surveys and preconstruction surveys of the proposed transmission line route and the wellfield and power plant area shall be carried out. Currently-identified populations of special-status species (particularly Hall's sedge, sugar stick, gray penstemon, and volcanic daisy populations) shall be marked and avoided. Detailed surveys for additional special-status species shall be carried out and populations marked and avoided. Populations of CNPS List 1 and 2 plants and Category 2 plants listed in the Northwest Forest Plan shall be avoided with sufficient buffer to protect the population. Where possible, other special-status plant species, such as CNPS List 3 and 4, USFS Special Interest, and Presidents Forest Plan Category 3 and 4 species shall be avoided where possible. (C)

4.7.3b Maintenance plans and emergency access plans shall include maps of special status species in the area that must be avoided. (O)

Level of Significance After Mitigation

Less than significant.

4.7.4 Effects on Sensitive Plant Communities

The construction, operation, and decommissioning of the transmission line could result in the loss and disturbance of sensitive meadow habitat near Medicine Lake and on the

Modoc Plateau (see impact 4.7.1 for a discussion of potential effects to late seral stage forest and snags). The construction, operation, and decommissioning of the power plant and wellfield area and temporary freshwater pipeline would not affect any sensitive plant communities. After the implementation of the identified mitigation measures, effects to sensitive plant communities would not be significant.

Construction: No sensitive plant communities exist in the power plant and wellfield area, along the proposed freshwater pipeline route, or along segment B2. There would therefore be no potential to affect sensitive plant communities from development of project facilities in these areas.

The meadow area identified along segment A1 between Medicine Lake and the Medicine Lake Glass Flow (see Figure 3.7-2) may meet the criteria for wetlands. The northern end of the meadow is located about 150 feet south of the Medicine Lake Glass Flow, and the meadow is approximately 750 feet long (i.e., from west to east) at this location. The understory in the meadow is composed of a variety of species adapted to extended periods of high soil moisture, and the meadow is overtopped by lodgepole pines.

Approximately 1.7 acres of this meadow habitat could be affected by the construction of segment A1 through the development of access roads through the meadow and construction activities for the transmission line itself. Mitigation measures are identified to avoid potential impacts to the meadow area from segment A1 construction.

Several dispersed, small, low-lying areas with accumulated soil moisture that may meet wetland criteria exist along C1 of the transmission line, and impacts to up to 0.6 acres of these potential wetlands could occur as a result of construction activities. Potential effects to sensitive plant communities along C1 could be avoided due to the dispersed and limited nature of these potential wetlands. This impact would be considered less than significant after the implementation of mitigation measures described below.

Operation: Transmission line maintenance activities may impact the meadow area near Medicine Lake. Additionally, potentially adverse effects on this wetland resource could result from access roads passing through this meadow. Partial restoration of habitat through revegetation could occur during the operation phase of the project, and therefore effects on sensitive plant communities during operation would be considered less than significant after the implementation of identified mitigation measures.

Decommissioning: Re-disturbance of the meadow area near Medicine Lake could occur during decommissioning of the transmission line, resulting in additional loss of habitat. Partial restoration of habitat through revegetation would occur during the decommissioning phase of the project; however, if re-disturbance of the meadow occurs, effects on sensitive plant communities during decommissioning would be similar to those described for the construction phase.

Mitigation Measures

The following mitigation measures are recommended to avoid significant effects to sensitive plant communities along the transmission line:

4.7.4a In order to avoid the meadow north of Medicine Lake, the portion of segment A1 of the transmission line corridor near the meadow shall be relocated to be

routed north of this meadow, between the meadow and the Medicine Lake Glass Flow. The transmission line at this location shall be constructed to avoid the meadow and its 150-foot Riparian Reserve buffer zone by ensuring that the transmission line poles are located such that the transmission line spans any portion of the meadow or its buffer zone underneath the line. Access roads shall not be located in the meadow area or in its buffer zone, and construction activities shall avoid this meadow and its buffer zone. (C)

4.7.4b The dispersed, small potential wetland areas along segment C1 or C2 of the transmission line shall be avoided. A qualified biologist shall delineate the extent of these potential wetland areas prior to construction, and transmission line facilities shall be sited to avoid these areas. Habitat disturbance in areas other than potential wetland habitat shall be minimized, and construction activities shall be timed to avoid periods of wet weather in which habitat disturbance (e.g., soil erosion and compaction) may be greater. Access roads and support structures for this portion of segment C1 or C2 shall be placed in uplands. (C)

4.7.4c All vehicular activity shall be restricted to existing roads and new roads, and all new roads shall be constructed only in upland areas. (C, O, D)

Level of Significance After Mitigation

Less than significant.

4.7.5 Introduction of Weeds

During project construction and maintenance, the seeds of weedy plants could be introduced into the project area by construction and maintenance vehicles. Table 4.7-1a shows invasive exotic plants known to occur on the Modoc Forest. While the introduction of weeds would not be considered a significant effect, avoidance of weed introduction would be desirable. The implementation of identified mitigation measures would avoid this effect, and minimize the potential for weed introduction.

Construction: During project construction, the seeds of weedy plants could be introduced into the project area by construction vehicles. The disturbed soil in these areas could provide habitat in which these species become established. Weedy species could compete with native species for habitat, and in many cases, could outcompete the native species for habitat. Weeds could also spread into areas disturbed by pre-project activities, and aggressive species could potentially colonize undisturbed habitats. Mitigation measures would avoid introduction and establishment of weedy plant species into the project area.

Operation: Without appropriate control measures, the seeds of weedy plants could be introduced into the project area by maintenance vehicles and colonize both disturbed and undisturbed habitats in the project area.

Decommissioning: Decommissioning activities could result in the establishment of weedy plants introduced as seeds on vehicle tires used for project activities. Mitigation measures would avoid the introduction and establishment of weedy plants into disturbed and undisturbed habitats in the project area.

Mitigation Measures

Although the introduction of weeds would not be considered a significant effect, the following mitigation measure is recommended to avoid this effect and to minimize the

Table 4.7-1a: Invasive Exotic Plants Known to Occur on the Modoc National Forest

Species	CalEPPC List[1]	CDFA List[2]
Acroptilon repens Russian knapweed	--	B
Carduus acanthoides plumeless thistle	Need More Information	A
Centaurea solstitialis yellow star thistle	A-1	C
Centaurea squarrosa squarerose knapweed	--	A
Conium maculatum poison hemlock	B	--
Hypericum perforatum Klamathweed	--	C
Isatis tinctoria Dyers woad	Need More Information	B
Linaria genistifolia ssp. *Dalmatica* Dalmation toadflax	--	A
Melilotus officinalis sweet clover	Considered But Not Listed (restricted to disturbed sites)	--
Onopordum acanthium ssp. *Acanthium* Scotch thistle	--	A
Salvia aethiopis Mediterranean sage	Need More Information	B
Tribulus terrestris puncture vine	--	C

Notes:

1 California Exotic Pest Plant Council Lists: A-1 = Most Invasive Wildland Pest Plants: Widespread; B = Wildland Pest Plants of Lesser Invasiveness; Need More Information = Species' status is uncertain; more information is needed.

2 California Department of Food and Agriculture Lists: A = The agency mandates that these species be targeted for eradication or containment; B = These species are more widespread and therefore difficult to contain and the agency allows county Agricultural Commissioners to decide whether to target them for eradication or containment in their jurisdictions; C = These weeds are so widespread that the agency does not endorse state- or county-funded eradication or containment efforts except in nurseries or seed lots.

SOURCES: USFS 1991; CAL EPPC 1996; CDFA 1998

potential for weed introduction:

4.7.5a Calpine shall develop and implement a weed control plan under the direction of the USFS. This plan shall be modeled on the plan for the Tuscarora natural gas pipeline project segment on the Modoc National Forest, and shall include the following elements:

- Development of a list of weeds for which control measures are required
- An inventory of existing weed infestations within the project area
- Wash stations for construction vehicles entering the project area and at staging areas along the transmission line route
- Post-construction monitoring and control of weed infestations that will occur periodically throughout the life of the project, under the direction of the USFS. (C, O, D)

Level of Significance After Mitigation

Less than significant.

ALTERNATIVES

Estimated vegetation loss and disturbance for all alternatives is presented in Table 4.7-2 according to vegetation type. Affected vegetation is categorized into vegetation removed, removed-converted, and disturbed. The vegetation loss categories are described above under the proposed action. Alternatives 2 through 6 are discussed below, according to those effects on general vegetation, special status species, and sensitive plant communities that are different from the proposed action (Alternative 1). The potential depositional effect on vegetation of each of the alternatives would be the same as described for the proposed action, as would the potential for introduction of weeds.

Alternative 2 (Segments A1, A2, B1, and C2)

Alternative 2 differs from the proposed action by the substitution of transmission line segment C2 for segment C1 and a correspondingly different location of the substation at the end of the transmission line. Alternative 2 would have the same effects as the proposed action for the construction, operation, and decommissioning of the power plant, wellfield, temporary freshwater pipeline, and transmission line segments A1, A2, and B1.

Effects on General Vegetation: A total of approximately 393.0 acres of general vegetation would be affected (343.3 acres by the transmission line) under Alternative 2, which would be about 4.5 acres more than the proposed action. The transmission line would be about 1.4 miles longer under Alternative 2 than under the proposed action. In comparison to the proposed action, this alternative would cross a larger area of sagebrush scrub, but a smaller area of rabbitbrush scrub and northern juniper woodland. About 172.4 acres of the total vegetation affected by this alternative would be loss of vegetation due to removal and clearance of vegetation at the power plant and wellfield and along the transmission line. This total loss would be about 1.9 acres less than the proposed action.

Table 4.7-2: Habitat Loss and Disturbance Along the Proposed and Alternative Transmission Line Routes (in acres) [1]

	RFF	UMMC	LPF	MEAD	HERB	ROCK	DIST	LMMC	PPF	PPP	BIG	RAB	JUN	AG	Total[2]
Proposed Action															
Removed	7.9	21.5	47.4	0.7	0.8	0.0	0.5	8.7	9.1	8.6	5.1	7.0	10.2	0.0	127.6
Removed-converted	9.9	31.8	72.1	0.9	1.3	0.0	0.3	6.5	6.7	3.9	0.0	2.6	0.0	0.0	136.0
Disturbed	2.9	9.4	21.1	0.7	0.4	0.0	0.5	10.4	10.8	7.9	2.4	5.3	3.5	0.0	75.2
Total	20.7	62.7	140.6	2.3	2.5	0.0	1.3	25.6	26.6	20.4	7.5	14.2	13.7	0.0	338.8
Alternative 2															
Removed	7.9	21.5	47.4	1.0	0.8	0.0	0.4	8.7	8.9	7.7	12.3	3.9	5.1	0.1	125.7
Removed-converted	9.9	31.8	72.1	1.7	1.3	0.0	0.3	6.5	6.7	4.9	4.6	2.5	0.8	0.0	143.1
Disturbed	2.9	9.4	21.1	1.1	0.4	0.0	0.4	10.4	10.7	7.5	6.2	3.3	1.0	0.1	74.5
Total	20.7	62.7	140.6	3.8	2.5	0.0	1.1	25.6	26.3	20.0	23.1	9.7	4.0	0.2	343.3
Alternative 3															
Removed	0.0	32.9	21.3	0.7	0.6	0.0	1.0	10.6	18.7	5.0	5.1	4.4	10.2	0.0	110.5
Removed-converted	0.0	73.6	39.9	0.9	1.0	0.0	0.9	12.8	22.2	1.9	0.0	0.6	0.0	0.0	154.0
Disturbed	0.0	20.5	11.3	0.7	0.3	0.0	2.2	28.2	49.0	5.9	2.4	2.1	3.5	0.0	126.1
Total	0.0	127.1	72.5	2.3	1.9	0.0	4.1	51.7	89.9	12.8	7.5	7.1	10.7	0.0	390.6
Alternative 4															
Removed	0.0	32.9	21.3	1.0	0.6	0.0	1.0	10.6	18.5	4.1	12.3	1.3	5.1	0.1	108.7
Removed-converted	0.0	73.6	39.9	1.7	1.0	0.0	0.9	12.8	22.2	2.9	4.6	0.5	0.9	0.0	161.1
Disturbed	0.0	20.5	11.3	1.1	0.3	0.0	2.2	28.2	48.9	5.4	6.2	0.1	1.0	0.1	125.3
Total	0.0	127.1	72.5	3.8	1.9	0.0	4.1	51.6	89.6	12.4	23.1	1.9	4.0	0.2	395.1

Table 4.7-2: Habitat Loss and Disturbance Along the Proposed and Alternative Transmission Line Routes, continued (in acres)[1]

	RFF[2]	UMMC	LPF	MEAD	HERB	ROCK	DIST	LMMC	PPF	PPP	BIG	RAB	JUN	AG	Total[2]
Alternative 5															
Removed	0.0	32.4	33.8	0.1	0.0	0.4	1.4	8.7	9.1	8.6	5.1	6.9	10.2	0.0	116.8
Removed-converted	0.0	59.1	53.9	0.2	0.0	0.8	2.2	6.5	6.7	3.9	0.0	1.8	0.0	0.0	135.0
Disturbed	0.0	17.2	15.8	0.3	0.0	0.2	1.0	10.4	10.8	7.9	2.4	5.0	3.5	0.0	74.6
Total	0.0	108.7	103.5	0.6	0.0	1.4	4.6	25.6	26.6	20.5	7.5	13.6	10.7	0.0	326.3
Alternative 6															
Removed	0.0	32.4	33.8	0.4	0.0	0.4	1.3	8.7	8.9	7.7	12.2	3.9	5.1	0.1	114.9
Removed-converted	0.0	59.1	53.9	1.0	0.0	0.8	2.2	6.5	6.7	4.9	4.2	2.1	0.8	0.0	142.1
Disturbed	0.0	17.2	15.8	0.7	0.0	0.2	1.0	10.4	10.7	7.5	5.5	3.8	1.0	0.1	73.8
Total	0.0	108.7	103.5	2.1	0.0	1.4	4.5	25.6	26.3	20.0	21.8	9.7	4.0	0.2	330.8

RFF = Red Fir Forest
UMMC = Upper Montane Mixed Conifer Forest
LPF = Lodgepole Pine Forest
MEAD = Meadow
HERB = Herbaceous
ROCK = Rock outcropping
DIST = Disturbed
LMMC = Lower Montane Mixed Conifer Forest
PPF = Ponderosa Pine Forest
PPP = Ponderosa Pine Plantation
BIG = Big Sagebrush
RAB = Rabbitbrush Sage
JUN = Juniper Woodland
AG = Agricultural

Notes:

[1] This table does not include the acreage for the power plant as the acreage would be the same as shown on Table 4.7-1 for Alternatives 2 through 8. See Table 4.7-1 for details of habitat loss at the power plant and wellfield area.

[2] Acreages may not total due to rounding.

SOURCE: Leitner 1997

The total vegetation loss of 172.4 acres associated with construction of Alternative 2 would not be a significant adverse impact because vegetation loss would almost entirely affect vegetation communities that are common and widespread in the region. Although the overall effect on general vegetation would not be significant, the transmission line under this alternative does have the potential to affect isolated stands of late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches. Mitigation measures identified for the proposed action would also apply to this alternative, and would reduce effects to general vegetation to less-than-significant levels.

Effects on Special-Status Species: Potential effects to special-status plant species at the proposed power plant, wellfield, and temporary freshwater pipeline, and along transmission line segments A1, A2, and B1 would be the same under this alternative as under the proposed action. This alternative would also have the potential to affect special-status plant species at the large vernal marsh known as Dry Lake located along the eastern portion of transmission line segment C2 (see Figure 3.7-8). Dry Lake contains known populations of two rare plants (Newberry's potentilla and playa phacelia).

Dry Lake also contains potentially suitable habitat for 16 other special-status plant species (see Table 3.7-5); most of these species occur in areas with prolonged soil moisture (i.e., the habitats found near or in Dry Lake). Potential habitat also exists along segment C2 in sagebrush scrub and juniper woodland areas for tall woolly marbles, Baker's globe mallow, gray penstemon, and volcanic daisy.

Mitigation measures identified for the proposed action would also apply to this alternative, and would ensure that any special-status plant species present in potential habitat along the transmission line would not be significantly affected by the project.

Effects on Sensitive Plant Communities: Alternative 2 would affect sensitive meadow habitat near Medicine Lake and on the Modoc Plateau. This alternative would affect approximately 3.8 acres of sensitive plant communities, which would be about 1.5 acres more than the proposed action. Effects to the meadow habitat along segment A1 near Medicine Lake would be the same as described for the proposed action; mitigation measures identified for the proposed action would apply to this alternative, and would reduce this effect to less-than-significant levels.

On the Modoc Plateau, segment C2 of Alternative 2 would affect approximately 0.8 acre of dispersed, small, low-lying areas with accumulated soil moisture that may meet wetland criteria, as well as 1.3 acres of potential wetlands at Dry Lake. With implementation of Mitigation Measure 4.7.4b, significant effects to the sensitive plant communities dispersed along segment C2 and at Dry Lake would be avoided.

Alternative 3 (Segments A1, B2, and C1)

Alternative 3 differs from the proposed action by the substitution of transmission line segment B2 for segments A2 and B1. This transmission line route would extend south of Red Shale Butte and Lyon's Peak before heading north to connect with segment C1. Alternative 3 would have the same effects as the proposed action for the construction,

operation, and decommissioning of the power plant, wellfield, temporary freshwater pipeline, and segments A1 and C1 of the transmission line.

Effects on General Vegetation: A total of approximately 440.3 acres of general vegetation would be affected (390.6 acres by the transmission line) under Alternative 3, which would be about 51.8 acres more than the proposed action. The transmission line would be about 2.3 miles longer under Alternative 3 than under the proposed action. In comparison to the proposed action, this alternative would cross through more upper and lower montane mixed conifer forest and ponderosa pine forest, but less red fir forest and lodgepole pine forest. About 157.2 acres of the total vegetation affected by this alternative would be loss of vegetation due to removal and clearance of vegetation at the power plant and wellfield and along the transmission line. This total loss would be about 17.1 acres less than the proposed action.

The total vegetation loss of 157.2 acres associated with construction of Alternative 3 would not be a significant adverse impact because vegetation loss would almost entirely affect vegetation communities that are common and widespread in the region. Although the overall effect on general vegetation would not be significant, the transmission line under this alternative does have the potential to affect isolated stands of late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches. Mitigation measures identified for the proposed action would also apply to this alternative, and would reduce effects to general vegetation to less-than-significant levels.

Effects on Special-Status Species: Potential effects to special-status plant species at the proposed power plant, wellfield, and temporary freshwater pipeline, and along transmission line segments A1 and C1 would be the same under this alternative as under the proposed action.

Along segment B2, potentially suitable habitat may exist for sugar stick, California pinefoot, and Hall's sedge in the upper elevations on the western portion of this segment. Potentially suitable habitat may exist for gray penstemon in the middle to lower elevations in the eastern portion of segment B2. Marginal habitat may be present at the lowest elevations of this segment for tall woolly marbles and Baker's globe mallow.

Mitigation measures identified for the proposed action would also apply to this alternative, and would ensure that any special-status plant species present in potential habitat along the transmission line would not be significantly affected by the project.

Effects on Sensitive Plant Communities: Alternative 3 would affect 2.3 acres of sensitive meadow habitat near Medicine Lake and on the Modoc Plateau, as described under the proposed action. Mitigation measures identified for the proposed action would apply to this alternative, and would reduce this effect to less-than-significant levels.

Segment B2 would pass through approximately 0.5 mile of a white fir-dominated forest in the Medicine Lake Highlands MLSA, directly south of the Glass Mountain Geologic Area. Approximately 0.25 miles of late seral stage forest would be removed. Mitigation identified for impact 4.7.1 of the proposed action would also apply to the effects to the

late seral stage forest in the Medicine Lake Highlands MLSA under this alternative. This mitigation measure would reduce this effect to less-than-significant levels.

Alternative 4 (Segments A1, B2, and C2)
Alternative 4 would be similar to Alternative 3 except that it would follow segment C2 north to avoid Tionesta, rather than following segment C1. Alternative 4 would have the same effects as the proposed action for the construction, operation, and decommissioning of the power plant, wellfield, temporary freshwater pipeline, and segment A1 of the transmission line.

Effects on General Vegetation: A total of approximately 444.8 acres of general vegetation would be affected (395.1 acres by the transmission line) under Alternative 4, which would be about 56.3 acres more than the proposed action. The transmission line would be about 3.7 miles longer under Alternative 4 than under the proposed action, and (at 27.1 miles) is the longest transmission line route under consideration. In comparison to the proposed action, this alternative would cross through more lower montane mixed conifer forest and ponderosa pine forest but less red fir forest and lodgepole pine forest. About 155.4 acres of the total vegetation affected by this alternative would be loss of vegetation due to removal and clearance of vegetation at the power plant and wellfield and along the transmission line. This total loss would be about 18.9 acres less than the proposed action.

The total vegetation loss of 155.4 acres associated with construction of Alternative 4 would not be a significant adverse impact because vegetation loss would almost entirely affect vegetation communities that are common and widespread in the region. Although the overall effect on general vegetation would not be significant, the transmission line under this alternative does have the potential to affect isolated stands of late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches. Mitigation measures identified for the proposed action would also apply to this alternative, and would reduce effects to general vegetation to less-than-significant levels.

Effects on Special-Status Species: Potential effects to special-status plant species at the proposed power plant, wellfield, and temporary freshwater pipeline, and along transmission line segment A1 would be the same under this alternative as under the proposed action. Potential effects to special-status plant species along segment B2 are described under Alternative 3, and potential effects to special-status plant species along segment C2 are described under Alternative 2. Mitigation measures identified for the proposed action would also apply to this alternative, and would ensure that any special-status plant species present in potential habitat along the transmission line would not be significantly affected by the project.

Effects on Sensitive Plant Communities: Alternative 4 would affect sensitive meadow habitat near Medicine Lake and on the Modoc Plateau. This alternative would affect approximately 3.8 acres of sensitive plant communities, which would be about 1.5 acres more than the proposed action. Effects to the meadow habitat along segment A1 near Medicine Lake would be the same as described for the proposed action; mitigation measures identified for the proposed action would apply to this alternative, and would reduce this effect to less-than-significant levels.

On the Modoc Plateau, the potential effects to sensitive plant communities from implementation of segment C2 under this alternative would the same as described under Alternative 2. In order to avoid significant effects to the sensitive plant communities dispersed along segment C2 and at Dry Lake, Mitigation Measure 4.7.4b would apply.

As discussed under Alternative 3, segment B2 would pass through approximately 0.5 miles of a white fir-dominated forest in the Medicine Lake Highlands MLSA, and approximately 0.25 miles of late seral stage forest would be removed. Mitigation identified for impact 4.7.1 of the proposed action would also apply to the effects to the late seral stage forest in the Medicine Lake Highlands MLSA under this alternative. This mitigation measure would reduce this effect to less-than-significant levels.

Alternative 5 (Segments A3, B1, and C1)

Alternative 5 differs from the proposed action by the substitution of transmission line segment A3 for segments A1 and A2. Segment A3 extends north from the power plant, passing to the west of Fourmile Hill. This segment then extends east following a route to the north of Mt. Hoffman. Alternative 5 would have the same effects as the proposed action for the construction, operation, and decommissioning of the power plant, wellfield, temporary freshwater pipeline, and segments B1 and C1 of the transmission line.

Effects on General Vegetation: A total of approximately 376.0 acres of general vegetation would be affected (326.3 acres by the transmission line) under Alternative 5, which would be about 12.5 acres less than the proposed action. The transmission line would be about the same length under Alternative 5 as under the proposed action. In comparison to the proposed action, this alternative would cross through more upper montane mixed conifer forest and ponderosa pine forest, but less red fir forest and lodgepole pine forest. Segment A3 of the transmission line would be located below late seral areas, on the border of high quality late seral areas and low quality logged areas. About 163.5 acres of the total vegetation affected by this alternative would be loss of vegetation due to removal and clearance of vegetation at the power plant and wellfield and along the transmission line. This total loss would be about 10.8 acres less than the proposed action.

The total vegetation loss of 163.5 acres associated with construction of Alternative 5 would not be a significant adverse impact because vegetation loss would almost entirely affect vegetation communities that are common and widespread in the region. Although the overall effect on general vegetation would not be significant, the transmission line under this alternative does have the potential to affect isolated stands of late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches. Mitigation measures identified for the proposed action would also apply to this alternative, and would reduce effects to general vegetation to less-than-significant levels.

Effects on Special-Status Species: Potential effects to special-status plant species at the proposed power plant, wellfield, and temporary freshwater pipeline, and along transmission line segments B1 and C1 would be the same under this alternative as under the proposed action.

Along segment A3, potentially suitable habitat may exist for sugar stick, California pinefoot, and Hall's sedge in the upper elevations on the western portion of this segment. Potentially suitable habitat may exist for gray penstemon in the middle to lower elevations in the eastern portion of segment A3. Marginal habitat may be present at the lowest elevations of this segment for tall woolly marbles and Baker's globe mallow.

Mitigation measures identified for the proposed action would also apply to this alternative, and would ensure that any special-status plant species present in potential habitat along the transmission line would not be significantly affected by the project.

Effects on Sensitive Plant Communities: This alternative would affect approximately 0.6 acres of sensitive plant communities, which would be about 1.7 acres less than the proposed action. These effects would occur along segment C1, as described under the proposed action. Mitigation measures identified for the proposed action for segment C1 would apply to this alternative, and would reduce this effect to less-than-significant levels.

No sensitive plant communities exist along segment A3. There would therefore be no potential to affect sensitive plant communities from development of segment A3 of the transmission line under Alternative 5. In addition, Alternative 5 would avoid effects to sensitive meadow habitat near Medicine Lake since the transmission line would not be located at this meadow area under this alternative. The mitigation measure identified for this effect of the proposed action would therefore not apply to this alternative.

Alternative 6 (Segments A3, B1, and C2)

Alternative 6 is similar to Alternative 5 except that it follows segment C2 rather than segment C1. Alternative 6 would have the same effects as the proposed action for the construction, operation, and decommissioning of the power plant, wellfield, temporary freshwater pipeline, and segment B1 of the transmission line.

Effects on General Vegetation: A total of approximately 380.5 acres of general vegetation would be affected (330.8 acres by the transmission line) under Alternative 6, which would be about 8.0 acres less than the proposed action. The transmission line would be about 1.2 miles longer under Alternative 6 than under the proposed action. In comparison to the proposed action, this alternative would cross through more upper montane mixed conifer forest and ponderosa pine forest, but less red fir forest and lodgepole pine forest. Segment A3 of the transmission line would be located below late seral areas, on the border of high quality late seral areas and low quality logged areas. About 161.6 acres of the total vegetation affected by this alternative would be loss of vegetation due to removal and clearance of vegetation at the power plant and wellfield and along the transmission line. This total loss would be about 12.7 acres less than the proposed action.

The total vegetation loss of 161.6 acres associated with construction of Alternative 6 would not be a significant adverse impact because vegetation loss would almost entirely affect vegetation communities that are common and widespread in the region. Although the overall effect on general vegetation would not be significant, the transmission line under this alternative does have the potential to affect isolated stands

of late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches. Mitigation measures identified for the proposed action would also apply to this alternative, and would reduce effects to general vegetation to less-than-significant levels.

Effects on Special-Status Species: Potential effects to special-status plant species at the proposed power plant, wellfield, and temporary freshwater pipeline, and along transmission line segment B1 would be the same under this alternative as under the proposed action. Potential effects to special-status plant species along segment A3 are described under Alternative 5, and potential effects to special-status plant species along segment C2 are described under Alternative 2. Mitigation measures identified for the proposed action would also apply to this alternative, and would ensure that any special-status plant species present in potential habitat along the transmission line would not be significantly affected by the project.

Effects on Sensitive Plant Communities: Alternative 6 would affect approximately 2.1 acres of sensitive plant communities, which would be about 0.2 acres less than the proposed action. These effects would occur along segment C2, as described under Alternative 2. In order to avoid significant effects to the sensitive plant communities dispersed along segment C2 and at Dry Lake, Mitigation Measure 4.7.4b would apply.

No sensitive plant communities exist along segment A3. There would therefore be no potential to affect sensitive plant communities from development of segment A3 of the transmission line under Alternative 6. In addition, Alternative 6 would avoid effects to sensitive meadow habitat near Medicine Lake since the transmission line would not be located at this meadow area under this alternative. The mitigation measure identified for this effect of the proposed action would therefore not apply to this alternative.

Alternative 7

There would be no effect on vegetation under Alternative 7, the No Action alternative. No mitigation measures would apply to this alternative.

4.8 Wildlife

REGULATORY FRAMEWORK

Both Federal and state laws provide for the protection and consideration of special-status wildlife species.

Federal

Federal law requires that all Federal departments and agencies shall use their authority to conserve endangered and threatened species as defined in the Federal Endangered Species Act (FESA). The Act defines as "endangered" any species that is in danger of extinction throughout all or a significant portion of its range, and as "threatened" any species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Two other special-status categories are recognized under FESA: (1) proposed for listing as threatened or endangered and (2) species of concern. "Proposed" endangered and threatened species are those species for which a proposed regulation has been published in the Federal Register, but not a final rule. "Species of Concern" is the current designation of species formerly identified as "candidate" for listing in the Federal Register.

Section 9 of FESA prohibits the "taking" of listed species. Under Section 7 of FESA, Federal agencies are directed to consult with the USFWS to ensure that no agency actions would jeopardize the continued existence of any listed species or result in the destruction of critical habitat. Although FESA requires formal consultation only for those species currently listed as threatened or endangered, the USFWS recommends that adverse impacts on species proposed for listing and species of concern also be considered because they may become listed during the design and construction phases of a project.

Region 5 of the USFS has identified a number of wildlife species as "sensitive". Many are species associated with late successional or old growth forest habitats and may be affected adversely by human activities that modify such habitats. The USFS has established policies and regulations designed to protect such species and their habitats, thus ensuring the maintenance of viable populations on USFS lands. The Land and Resource Management Plans (LRMPs) for the Modoc and Klamath National Forests set forth special management goals and directives to ensure that viable populations are maintained on USFS lands. The Modoc National Forest has established a list of "Management Indicator Species" (MIS). The Klamath National Forest has identified "Species Associations" (SA) that are special-status species associated with particular habitat types. Species listed under both the MIS and SA designations include wildlife harvested as game, ecological indicator species, and special interest species.

The Northwest Forest Plan provides guidance to the USFS for protection of wildlife species associated with late successional forest habitats. The guidelines for the protection of these species are currently being developed, but those species listed as Category 2, "survey and manage" are treated in this document as special-status species.

State

The California Endangered Species Act (CESA) provides protection for endangered and threatened wildlife species as well. For proposed projects that may or would have an adverse effect on state-listed species, a formal consultation process must be initiated with the CDFG.

In addition to requiring consultation regarding potential adverse impacts to endangered and threatened wildlife, the CDFG currently maintains a list of "Species of Special Concern". These animal species are not listed as endangered or threatened by the State of California at present, but there is a concern that, if current trends continue, they may require official listing in the future. By identifying Species of Special Concern, the CDFG draws attention to the need for protective measures that would prevent the need to designate them as endangered or threatened in the future.

KEY ISSUES

The key wildlife issues identified and evaluated in this section relate to the effects of the project on general wildlife habitat and special-status species, such as the northern spotted owl, the northern goshawk, and bats. These effects are evaluated in Impacts 4.4.81, and 4.8.3.

SIGNIFICANCE CRITERIA

Federal and California endangered species laws require protection of listed endangered or threatened animal species. Other special-status species include those proposed for listing or designated as species of concern by the USFWS, as well as species of special concern identified by the CDFG. If the proposed action would affect the range of, or eliminate an endangered, threatened, or other special-status animal species, or result in take of such species, it would be considered a significant impact.

The USFS has established a list of "Sensitive" species, and the Modoc and Klamath National Forests have established lists of MIS and SA species. If the proposed action would significantly affect the range, result in significant take, or eliminate any wildlife species designated as Sensitive, MIS, or SA, it would be considered a significant impact.

Section 15065(a) of the CEQA Guidelines specifies that a lead agency shall find that a project may have a significant effect on the environment when the project has the potential to substantially reduce the habitat of a fish or wildlife species, threaten to eliminate an animal community, or reduce the number or restrict the range of a rare or endangered species. Appendix G of the CEQA Guidelines states that a project would normally have a significant effect on the environment if it would substantially affect a rare or endangered animal species or the habitat of the species or would substantially diminish habitat for fish or wildlife.

Section 15380 of the CEQA Guidelines further defines "rare and endangered species" as those species officially listed as threatened, endangered, or rare under Federal or California law. In addition, the Guidelines provide that animal species may be treated as "rare or endangered" even if not on one of the official lists under the following circumstances:

- The survival and reproduction of the species in the wild are in immediate jeopardy

- The species exists in such small numbers throughout all or a significant portion of its range that it may become endangered if its environment worsens
- The species is likely to become endangered in the foreseeable future and may be categorized as "threatened" under Federal law

PROPOSED ACTION

4.8.1 Potential for General Wildlife Habitat Loss

Construction of the proposed project would affect approximately 388.5 acres of general wildlife habitat (see Table 4.7-1). Of this total, approximately 174.3 acres would be considered to be actual loss of general wildlife habitat. This impact would not be significant because most of the affected habitat types are common and widespread in the area. However, effects to late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches would be significant, and mitigation is identified. No additional habitat would be lost during the operation and decommissioning phases of the proposed project; thus, the impacts during these phases would not be significant.

Construction: Construction of project facilities would affect approximately 388.5 acres of general wildlife habitat. Approximately 49.7 acres of wildlife habitat would be affected at the wellfield and power plant (including the freshwater pipeline), approximately 335.8 acres of habitat would be affected by construction of the proposed transmission line, and about 3.0 acres of habitat would be affected at the proposed substation site. Estimated affected habitat by vegetation type is presented in Table 4.7-1 for the proposed action.

At the wellfield and power plant, approximately 46.7 acres of wildlife habitat loss would occur due to development of the well pads, pipelines, power plant, and plant access roads (see Table 2.2-1, in Chapter 2 for disturbance calculations). About 3.0 acres of wildlife habitat would be disturbed from the installation of the temporary freshwater pipeline from Arnica Sink to the wellfield area; this pipeline would be hand laid and would not result in significant surface disturbance or habitat loss. Project construction at the wellfield and power plant would primarily affect lodgepole pine forest and upper montane mixed conifer forest. Approximately one acre of late seral stage red fir forest would be lost as a result of wellfield and power plant implementation.

Table 2.2-3 in Chapter 2 summarizes disturbance from transmission line implementation. Construction of the transmission line would have the greatest effect on lodgepole pine forest and upper montane mixed conifer forest. Along the transmission line corridor, about 124.6 acres of wildlife habitat would be removed, which would be considered a loss of general wildlife habitat. Approximately 136.0 acres of wildlife habitat would be converted from one habitat type to another, such as conversion of forest or woodland habitat to shrub or herbaceous cover that would still provide some wildlife habitat. This change would not be considered a loss of general wildlife habitat. Approximately 75.2 acres of wildlife habitat would require the topping of trees for transmission line construction; the habitat in this area would be disturbed, but would not be removed or converted, and would therefore not be considered a loss of general wildlife habitat. Construction of the proposed substation would result in the loss of about 3.0 acres of general wildlife habitat.

The total habitat loss of 174.3 acres associated with construction of the proposed action would not have a significant adverse impact on wildlife, because habitat loss would almost entirely affect habitat types that are common and widespread in the region. The proposed action would primarily affect lodgepole pine forest and upper montane mixed conifer forest, which are common and widespread habitat types in the region. In these areas, no significant loss of habitat features of special wildlife value is expected. In addition, four of the wellpad sites in the wellfield area are located on old log decks, and much of the remaining habitat that would be cleared has been disturbed by timber harvest in recent decades. Minimal clearance would be conducted for constructing project facilities in the wellfield and power plant area.

New roads associated with the transmission line could provide the public with access to portions of the project area that were previously inaccessible. If the public were to access these areas, any disturbance of wildlife would be expected to be temporary and sporadic, and would not be expected to significantly affect any wildlife species in the area. This effect would therefore be considered less than significant (see impact 4.8.2 for more information on wildlife effects from human noise and disturbance).

Although the overall effect on general vegetation would not be significant, the proposed transmission line does have the potential to affect isolated stands of late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches. These sensitive habitat features are dispersed throughout the Forest (including the vicinity of the transmission line). The acreage of these sensitive habitat features that would be affected would depend on the actual alignment of the transmission line. However, construction of the transmission line would be expected to result in unavoidable effects to late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches even with mitigation, and additional mitigation is identified to compensate for these effects and reduce the effect of the project to less-than-significant levels.

Operation: During the operation phase, vegetation management activities would be carried out as needed within the right-of-way to ensure reliable operation of the transmission line. Vegetation would be removed by hand and mechanical cutting. Vegetation management activities would control tall vegetation and encourage growth of low- growing plant species. Clearing would prevent natural succession from the herbaceous or shrub vegetation stage to second-growth forest; however, there will be no additional habitat loss for forest-adapted species. Species that require herbaceous vegetation will continue to benefit. No effects to fish are expected from deposition of geothermal air emissions on surface water, due to the low concentrations of constituents (see Section 4.13, Air Quality).

Decommissioning: During the decommissioning of the proposed action, structures and facilities would be dismantled and removed from the area. Project decommissioning would require the use of the same areas previously used during project construction. Decommissioning would therefore not be expected to affect or result in a loss of general wildlife habitat.

After all project structures and facilities are removed, these areas would be scarified and replanted with a mix of vegetation similar to the vegetation that existed in the disturbed areas prior to project implementation. All revegetation efforts would be conducted in

accordance with a revegetation plan, prepared under the direction of the USFS. The ultimate effect after revegetation would be to restore habitat previously lost or degraded in quality to essentially pre-project conditions. The proposed action, after decommissioning, would therefore not be expected to significantly affect wildlife habitat and wildlife populations in the project area.

Mitigation Measures

Loss of general wildlife habitat would be considered less than significant prior to mitigation, except for potential effects to late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches. Mitigation Measures 4.8.1a and 4.8.1b are identified to further reduce the less-than-significant effects to general vegetation. Mitigation Measures 4.8.1c through 4.8.1e are recommended to reduce effects to late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches to less-than-significant levels.

4.8.1a Vegetation management activities should use selective methods during construction. Selective methods, such as scalloping or clearance, should be used to trim or remove only vegetation with potential to interfere with construction of the transmission line. (C)

4.8.1b Vegetation management activities should use selective methods during operation. Selective methods, such as scalloping or clearance, should be used to trim or remove only vegetation with potential to interfere with transmission line operation. (O)

4.8.1c Minimize the removal of late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches during construction of the transmission line by locating transmission line facilities in areas such as log decks, previously logged forest stands, and areas of small class-size trees (i.e., smaller than 18 inches dbh), wherever possible. (C)

4.8.1d For stands of late seral stage forest that are lost due to project construction, compensation shall be provided by Calpine in accordance with the standards and guidelines of the Northwest Forest Plan (USFS and BLM 1994a). Compensation could include activities such as silvicultural enhancement in the form of thinning understory or prescribing underburning techniques of an acreage equivalent to that removed by project activities. The USFS shall identify appropriate sites for compensation through a collection agreement with Calpine prior to the commencement of construction activities. (C)

4.8.1e For trees and snags with dbh greater than or equal to 18 inches that are removed during construction, compensation shall be provided by Calpine in accordance with the standards and guidelines of the Northwest Forest Plan (USFS and BLM 1994a). Per these guidelines, all loss of snags with dbh of 18 inches or more shall be mitigated for at an off-site location that is a distance of 250 feet or more from any edge of an area cleared for project facilities. The trees selected for snag creation shall be inspected by a qualified wildlife biologist to ensure that they are not occupied by bats or other special-status wildlife. Snag creation (or other compensatory measures) could include killing live trees or accelerating the development of stands to increase tree senescence. (C)

Level of Significance After Mitigation

Less than significant.

4.8.2 Wildlife Effects from Noise and Disturbance

Construction, operation, and decommissioning of the proposed project would result in increased noise levels at the power plant and wellfield area and on the transmission line route that would cause reduced use of the area by general wildlife species. Neither the

direct impacts of project-generated noise nor the associated reduction in usable habitat would significantly affect general wildlife species. Refer to Section 4.14—Noise for more information on project noise levels and impacts.

Construction: Project activities that would produce noise with the potential to affect wildlife in nearby habitats would include construction of facilities such as well pads, transmission lines, pipelines, and the power plant, the drilling of production and injection wells, and the operation of a diesel-powered pump on the freshwater pipeline. Table 4.8-1 presents predicted noise levels that would occur during the construction phase at various distances from project noise sources. Project noise from all sources would be dominated by the lower frequencies; noise emissions in the high frequency and ultrasonic portions of the sound spectrum would be negligible and would not affect nearby wildlife, including bats.

Table 4.8-1: Predicted Noise Levels at Various Distances from Project Noise Sources

	Project	Noise Level (dBA)[2]		
Noise Source	**Phase[1]**	**200 feet**	**400 feet**	**800 feet**
Wellfield and Power Plant[3]	C, D	77	71	65
Transmission Line[3]	C, D	74	68	62
Power Plant Operation	O	78	72	66
Wellpad-infill Drilling	O	84	78	72

Notes:

[1] C = construction phase, O = operational phase, D = decommissioning phase

[2] Identified noise levels are given for various distances from a proposed noise-generating source. These noise levels do not account for the topographical barriers and trees throughout the project vicinity, both of which absorb or deflect sound waves, thereby reducing noise levels.

[3] Includes construction activities such as vegetation clearance, grading, and structure erection.

SOURCE: Leitner 1997 and MHA Environmental Consulting, Inc. 1997

Laboratory studies have demonstrated that long-term exposure (i.e., at least several days to weeks) to sound pressure levels of 80 dBA or greater can cause temporary or permanent hearing loss, as a well as a variety of adverse effects on other physiological systems (EPA 1971; Fletcher and Busnel 1978; Marler et al. 1973). Sound pressure levels of 70 to 75 dBA have the potential to cause wildlife to leave or avoid an area, particularly when such noise is accompanied by human activity and moving machinery that can also provide visual alarm stimulation. If noise levels of 70 to 75 dBA were

present on a long-term basis without the accompanying activity of humans or machines, wildlife (including bats) would gradually adapt to the noise, and the avoidance response would subside.

The combination of human activity, moving machinery, and associated noise would temporarily displace wildlife (especially birds, bats, and other mammals) from the habitat immediately adjacent to construction. Effects to wildlife from noise and disturbance would be temporary, because it would be concentrated in the summer and fall months over a three-year period. During drilling operations and construction of well pads and the power plant, about 50 to 60 acres of habitat at most would be impacted by noise and disturbance that could cause temporary displacement of wildlife. While the effects of construction noise could be adverse, impacts would be temporary and restricted to a relatively small area. Thus, the effects upon wildlife are not expected to be significant.

Based on the above studies, wildlife would be expected to temporarily avoid sites at which construction and well drilling are in active progress, maintaining distances of 200 to 400 feet from these sources of noise and disturbance. At distances beyond 400 feet (especially in forested areas), general wildlife use of the habitat would not be expected to be affected by project noise and human activity because tree cover would provide adequate screening. Long-term exposure to sound pressure levels above 80 to 85 dBA has been demonstrated to cause hearing loss and other adverse physiological effects to animals in a laboratory setting. However, wildlife (including bats) would not be expected to experience adverse physiological effects during the construction phase of the project because they would avoid areas within 200 feet of construction and well drilling activities.

Operation: Noise from operation of the power plant and from periodic drilling of make-up wells would occur throughout the operational phase of the proposed action. As discussed in Section 4.14—Noise, operation and routine maintenance of the geothermal wells would produce little noise as compared to operation of the power plant and periodic drilling of make-up wells. Table 4.8-1 presents predicted noise levels that would occur during the operational phase at various distances from project noise sources. As described in the construction phase, laboratory studies have demonstrated that long-term exposure (days to weeks) to sound pressure levels of 80 dBA or greater can cause temporary or permanent hearing loss, as well as a variety of adverse effects on other physiological systems (EPA 1971; Fletcher and Busnel 1978; Marler et al. 1973).

During normal operation of the power plant and the wellfield, human activity would be minimal and wildlife would be expected to utilize habitat in close proximity to project facilities. This expectation is supported by the results of an extensive wildlife study conducted at the Geysers Geothermal Project in northern California (Pacific Gas and Electric Company 1986). In this study, the population, relative abundance, and habitat utilization of ten wildlife groups and five vegetative habitat types were compared on developed and undeveloped sites. The developed study sites were located within wellfields near geothermal power plants. These study sites were sited in habitat that was not physically disturbed, but was exposed to the higher noise levels and disturbance characteristic of an operational geothermal project. The study found no difference in the distribution and abundance of wildlife at study sites close to

geothermal facilities as compared to study sites remote from development, due to the effects of geothermal development. Based on this research, noise impacts to general wildlife resources (including bats) would not be significant during normal operation.

During infill well drilling at well pads in the power plant and wellfield, temporarily elevated noise levels would occur in the immediate vicinity of the well pads where infill drilling would occur. These noise levels, which are identified in Table 4.8-1, would occur for about 30 days at a given well pad once every two years. Wildlife (including bats) would be expected to avoid these areas during infill drilling. Due to the temporary nature of this noise effect, wildlife use at adjacent habitat would not be expected to be significantly affected, as wildlife would return to these areas upon completion of infill drilling. Noise impacts on general wildlife resources would therefore not be significant during infill well drilling at the power plant and wellfield.

Decommissioning: During the decommissioning of the proposed action, the noise and human activity associated with dismantling and removing structures and facilities would be expected to temporarily displace wildlife in the immediate vicinity, but the ultimate effect would be to restore habitat previously lost or degraded in quality. Noise levels would be expected to be similar to those that would occur during project construction. After project decommissioning is completed, general wildlife presence and usage in the areas that were used by the proposed action would be expected to return to essentially pre-project levels. Noise from decommissioning would therefore not significantly affect general wildlife.

Mitigation Measures

The potential for effects to general wildlife from noise and disturbance would be considered less than significant prior to mitigation. However, the following mitigation measure is included to further reduce the potential for effects to general wildlife from noise and disturbance:

4.8.2a Use standard noise controls and reduction measures on construction, well drilling, and power plant equipment to minimize disturbance of general wildlife in the area. (C, O, D)

Level of Significance After Mitigation

Less than significant.

4.8.3 Effects on Special-Status Species

Development of the proposed project could result in the potential for significant effects to special-status species. Effects during construction would occur primarily from the removal and loss of habitat, and from potential disturbance (particularly of nesting activities) due to project-generated noise. Operational and decommissioning effects to special-status species would be due primarily to noise-related disturbance. Mitigation measures (such as compensation for habitat loss and limited construction and operating periods to avoid noise disturbance of particular species during nesting activities) are identified to reduce potential impacts to special-status species to less-than-significant levels.

Construction Effects: During the construction phase of the proposed action, impacts to special-status species could occur as a result of habitat loss, as well as noise and human disturbance.

Special-status species habitat would be lost from construction of project facilities at the wellfield and power plant area, and clearing of vegetation along the transmission line corridor. Table 4.8-2 shows estimates of the amount of habitat for special-status species that would be lost due to project construction. For all species, the removal of vegetation from project construction (as discussed under impact 4.8.1) has been considered in estimating habitat loss. For some species (such as the hairy woodpecker, northern spotted owl, and pileated woodpecker), the conversion of habitat from one type to another would be considered a loss of habitat for these species. Habitat conversion acreage has therefore been included in the habitat loss estimates for these species. Mitigation measures would reduce the effect of special-status species habitat loss to less-than-significant levels.

The proposed action could also affect special-status species through noise and human disturbance during construction, which could result in abandonment of a territory or reproductive failure. In general, the proposed action would not be expected to result in significant noise and human disturbance (see impact 4.8.2). Mitigation measures are identified that would ensure the noise and human disturbance effect of the proposed project on special-status species during construction would not be significant.

Bald eagle (Haliaeetus leucocephalus): Although bald eagles occasionally fly over segment A1 of the proposed transmission corridor and may roost in the vicinity, no foraging or nesting habitat would be lost due to construction. Noise and human disturbance is not expected to adversely affect bald eagles. Construction impacts to this species would not be considered significant.

Blue grouse (Dendrapagus obscurus): Impacts to this species would include the loss of about 128 acres of habitat, 50 at the wellfield and power plant area and 78 along the transmission line corridor. This habitat loss would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available within the Medicine Lake Highlands.

Cooper's hawk (Accipiter cooperii): About 154 acres of habitat suitable for Cooper's hawk would be lost as a result of the proposed action. Of this disturbance, 50 acres of foraging habitat would be lost in the power plant and wellfield area, and 104 acres along the transmission line corridor. Although much of the habitat that would be lost is suitable for nesting, no known nest sites have been identified in these areas. Removal of this habitat would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available within the Medicine Lake Highlands.

Cooper's hawks using nest sites in the conifer forest habitats on or adjacent to the proposed transmission corridor could be adversely affected by noise and disturbance from construction activities. This impact would be significant if it caused the hawks to abandon the nest or caused reproductive failure. Mitigation is defined to avoid a significant affect on nesting hawks.

Table 4.8-2: Special-Status Species Habitat Loss for The Proposed Action (in Acres)

Species	Alternative 1[1]
Birds	
Bald eagle[2]	0
Blue grouse[4]	128
Cooper's hawk[4]	154
Golden eagle[4]	175
Great gray owl[2]	<2
Greater sandhill crane[2]	0
Hairy woodpecker[3]	245
Loggerhead shrike[2]	20
Northern goshawk[4]	154
Northern spotted owl[3]	77
Osprey[2]	0
Pileated woodpecker[3,5]	243
Sage grouse[2]	12
Swainson's hawk[2]	20
Bats	
Fringed Myotis[4]	175
Long-Eared Myotis[4]	154
Long-Legged Myotis[4]	154
Pallid Bat[4]	175
Silver-Haired Bat[4]	154
Spotted Bat[2]	0
Townsend's Big-eared Bat[4]	175
Western Mastiff Bat[2]	0
Western Small-Footed Myotis	67
Other Mammals	
American badger[2]	20
American marten[4]	128
California wolverine[3,4]	250
Mule deer (summer/winter)[4]	175
Oregon snowshoe hare[4]	154
Pacific fisher[4]	128
Pronghorn[2]	20
Sierra Nevada red fox[3,4]	250
Invertebrates	
Klamath sideband[3,4,6]	250
Oregon shoulderband[3,4,6]	250
Papillose tail-dropper[3,4,6]	250

Notes:

1 Alternative 1 is the Proposed Action; includes the power plant and wellfield, temporary freshwater pipeline, and transmission line.

2 Little or no suitable habitat would be lost for this species.

3 All acreage of suitable habitat for this species that is converted from forest to shrub/herb counted as direct habitat loss for this species.

4 Acreage for this species includes 50 acres of habitat loss at the wellfield and power plant area.

5 Acreage for this species includes 3 acres of habitat loss at the wellfield and power plant area.

6 This species is associated with certain features within forested habitat such as rocky outcrops and patches of large woody debris; the abundance of these features within forested habitat in the project area is unknown, so the analysis assumes that these features occur throughout appropriate forested habitat within the project area.

SOURCE: Leitner 1997; USFS 1998

Golden eagle (Aquila chrysaetos): About 175 acres of foraging habitat suitable for golden eagles would be lost as a result to the proposed action. Approximately 50 acres of this total habitat loss would occur at the wellfield and power plant area, and 125 acres along the transmission line corridor. No known nest sites would be affected. The estimated habitat loss would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available within the region.

Great gray owl (Strix nebulosa): About 1.7 acres of potential great gray owl foraging habitat could be lost by construction of transmission line segment A1 in the vicinity of Medicine Lake. This species may use the meadow area along segment A1 between Medicine Lake and the Medicine Lake Glass Flow (see Figure 3.7-2). However, this meadow area is of marginal habitat value, and there is no direct evidence that the species utilizes this area. In addition, mitigation is identified in Section 3.7—Vegetation that would avoid effects to the meadow area from construction of transmission line segment A1. Habitat loss due to the construction of the project would therefore not be considered to be a significant impact on this species.

Greater sandhill crane (Grus canadensis babida): Greater sandhill cranes may fly over segment C1 of the proposed transmission line en route to breeding areas near the Oregon border and northeast of the project site. However, suitable foraging and breeding habitat for the greater sandhill crane does not exist in the proposed project area.

Hairy woodpecker (Picoides villosus): About 245 acres of habitat suitable for the hairy woodpecker would be lost due to transmission line construction. This loss would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available within the Medicine Lake Highlands.

Loggerhead shrike (Lanius ludovicianus): About 20 acres of habitat suitable for loggerhead shrike would be lost due to transmission line construction on segment C1. This habitat loss would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available.

Northern goshawk (Accipiter gentilis): About 154 acres of foraging habitat suitable for northern goshawk would be lost as a result of the proposed action. Approximately 50 acres of this loss would be in the power plant and well field area, and 104 acres along the transmission line corridor. No habitat would be lost in or near the red fir stand located near the wellfield that is used as a nest site (the Grouse Hill goshawk stand). Although the proposed transmission line route would affect about 27 acres of red fir forest that could provide potential nesting habitat, there has been no documentation of goshawk nest sites on or within 0.25 miles of the proposed transmission line corridor. The projected loss of foraging and potential nesting habitat would not have a significant impact on the species, since this loss would be spread throughout a large area and would affect only a small fraction of the total habitat available within the Medicine Lake Highlands.

Goshawks using the nest site in the west-central portion of the wellfield and power plant area (within the Grouse Hill goshawk stand) could be affected by noise and disturbance from construction and well drilling activities. As a part of project design, well pad locations were chosen and moved away from the existing nest site to avoid

this potential effect. The distance is considered to be adequate to sufficiently reduce noise effects. As a result, none of the well pads are located less than 0.25 mile from the goshawk stand, and only four well pads are located between 0.25 and 0.5 mile from the goshawk stand. No occupied goshawk nest sites are known to occur in proximity to other project facilities. Therefore, noise effects on goshawks are not expected to be significant. Mitigation is proposed to reduce the potential for adverse effects.

Northern Spotted Owl (Strix occidentalis caurina): There has been no sign or detection of northern spotted owl in the wellfield and power plant area or along the temporary freshwater pipeline or the proposed transmission line route. However, potential habitat does exist in the vicinity of these proposed facilities.

At the wellfield and power plant area, no suitable nesting or roosting habitat for the northern spotted owl exists within or adjacent to this area. Although possible foraging habitat for this species is scattered through the wellfield and power plant area, it is unlikely that the northern spotted owl uses this area due to the fragmented condition of potential habitat. No preferred habitat for this species would be affected by the proposed project in this area (Galea and Oberlag 1996).

Previous field surveys have not identified suitable habitat for the northern spotted owl along the temporary freshwater pipeline route. In addition, the freshwater pipeline would be hand-laid, and would result in no direct surface disturbance that would affect the foraging of northern spotted owls. However, some of the forested habitats within 0.25 miles of this temporary pipeline route fit the definition of suitable northern spotted owl nesting and foraging habitat, as defined by the USFS Doublehead Ranger District (Villegas 1997). Installation of this temporary pipeline could potentially affect northern spotted owl use of adjacent habitat.

Along the proposed transmission line route, no suitable nesting or foraging habitat was identified for the northern spotted owl by surveys conducted for the proposed project. However, the USFS Doublehead Ranger District considers portions of the proposed transmission line located in the Medicine Lake Highlands (i.e., segments A1 and A2 and the western portion of segment B1) to traverse or be adjacent to suitable nesting and foraging habitat for the northern spotted owl (Villegas 1997). Construction of this portion of the transmission line could therefore affect up to 77 acres of potential northern spotted owl habitat. This estimate includes forested areas that would be converted to shrub/herb areas, which cannot be used by the northern spotted owl.

Osprey (Pandion haliaetus): Although ospreys occasionally fly over segment A1 of the proposed transmission line and may use perches in the vicinity, no foraging or nesting habitat would be lost due to construction. No significant impacts would occur to osprey, and no habitat would be lost to construction or operation activities.

Pileated woodpecker (Dryocopus pileatus): Approximately 243 acres of habitat would be lost as a result of project construction. Of this acreage, a few acres of marginal foraging habitat would be lost in the power plant and wellfield area. Approximately 240 acres of forested habitat in the Medicine Lake Highlands would be lost due to transmission line construction; of this acreage, only the 21.7 acres of red fir forest loss along the transmission line would be considered loss of high quality habitat for pileated

woodpeckers. This loss of habitat would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available.

Sage grouse (Centrocercus urophasianus): About 12 acres of habitat suitable for sage grouse would be lost due to transmission line construction on segment C1. Loss of foraging habitat is not expected to have a significant impact on the species, since the area affected is only a small fraction of the total habitat available. However, loss of habitat in the form of traditional strutting grounds used during the spring breeding season would be considered a significant impact. Mitigation is defined to reduce the effect to a less-than-significant level.

Sage grouse using strutting grounds or nest sites in shrubland or juniper woodland habitats on or adjacent to the proposed transmission corridor could be adversely affected by noise and disturbance from construction activities. The project would cause a significant effect if the noise and disturbance from project construction interfere with nesting.

Swainson's hawk (Buteo swainsoni): About 20 acres of foraging habitat suitable for Swainson's hawk would be lost along segment C1 due to transmission line construction, and it is possible that nest sites could be affected. Loss of foraging habitat would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available. However, loss of nest sites would be considered a significant impact, and mitigation measures are identified to avoid this significant effect.

Swainson's hawks using nest sites in the juniper woodland habitat on or adjacent to the proposed transmission corridor could be adversely affected by noise and disturbance from construction activities. This construction could have a significant impact if noise and disturbance resulted in abandonment of a nest or reproductive failure. Mitigation is proposed to avoid a significant effect.

Pallid bat (Antrozous pallidus): About 175 acres of foraging habitat suitable for pallid bats would be lost due to project construction. This habitat loss would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available. Project avoidance of and compensation for high quality roosting habitat in the form of large snags and defective trees (see mitigation measures for impact 4.8.1) would prevent further impacts to this species.

Pallid bats are known to use tree roosts remote from human disturbance, but will also use both night and diurnal roosts in human-occupied structures, farm buildings, and highway bridges. Their exact level of tolerance for human activity and noise has not been systematically studied. However, a conservative approach can be taken to evaluating the potential impact to these species. If trees or snags used by pallid bats are located in areas adjacent to construction activity, these animals could be displaced to alternative roosts. Because pallid bats would be able to return following construction, no significant impacts to this species are expected to occur as a result of the proposed project.

Townsend's big-eared bat (Corynorhinus townsendii): About 175 acres of foraging habitat suitable for Townsend's big-eared bats would be lost due to construction of the project,

including transmission line and wellfield/power plant facilities. This habitat loss would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available. Project avoidance of high quality roosting habitat in the form of caves would prevent further impacts to this species.

Townsend's big-eared bats are particularly sensitive to noise and human disturbance, and this type of disturbance from project construction could affect this species. Mitigation measures are identified that would identify potential roosting sites prior to construction and enforce a 250-foot buffer zone around such sites. These measures would prevent impacts from project noise and ensure that this species would not be significantly affected.

Spotted bat (Euderma maculatum) and Western mastiff bat (Eumops perotis): No suitable habitat exists for the spotted and western mastiff bats in the wellfield and power plant area or along the temporary freshwater pipeline or the proposed transmission line route. No habitat for these species would be lost due to construction, and these species would not be affected by the project. No significant impacts to these bat species would occur.

Other special-status bat species (Myotis sp. and Lasionycteris noctivagans): Clearing of large snags and living trees with cavities may result in loss of diurnal roosting habitat for the other special-status bat species identified in Table 4.8-2 (i.e., bat species of the genus *Myotis* and silver-haired bats).

Within the power plant and wellfield, facilities would be sited to avoid large snags and trees with potential for diurnal roosts for these bat species. However, the transmission route would traverse an estimated 4.2 miles of habitat with high and medium suitability for diurnal roosts for these bat species in the form of large snags and trees. Construction of the transmission line in these areas would affect from 67 to 175 acres of potential bat habitat depending on the species (see Table 4.8-2). This habitat loss would not have a significant impact on the *Myotis sp.* and silver-haired bats, since the area affected would be only a small fraction of the total habitat available. Project avoidance of and compensation for high quality roosting habitat in the form of large snags and defective trees (see mitigation measures for impact 4.8.1) would prevent further impacts to this species. Potential effects to these special-status bat species from loss of roosting habitat would therefore not be significant.

Silver-haired bats and the special-status *Myotis* species are known to roost in trees and snags remote from human disturbance and may be sensitive to the kinds of human activity and noise that would be associated with the construction phase of the proposed project. Their exact level of tolerance for human activity and noise has not been systematically studied. However, a conservative approach can be taken to evaluating the potential impact to these species. If trees or snags used by these bat species are located in areas adjacent to construction activity, these animals could be displaced to alternative roosts. Because these special-status bat species would be able to return following construction, no significant impacts are expected to occur to these species as a result of the proposed project.

American badger (Taxidea taxus): About 20 acres of habitat suitable for American badger would be lost due to transmission line construction on segment C1. This habitat loss

would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available.

American marten (Martes americana): Approximately 128 acres of foraging habitat for American marten would be lost as a result of the proposed action. Approximately 50 acres of this would be in the power plant and well field area, and 78 acres along the transmission line corridor. Project facilities would be sited to avoid preferred denning habitat, which is late seral stage conifer forest and no den sites have been identified within the wellfield and power plant area. Nonetheless, it is still possible that construction activity could impact a previously unrecognized denning site. In addition, it is possible that den sites could be affected along the transmission line corridor. These potential effects would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available within the Medicine Lake Highlands.

California wolverine (Gulo gulo luteus): Up to 250 acres of marginal habitat may be available for the California wolverine in the project area. There is no evidence that this species is present in the area. Due to the rarity of the wolverine in California, the species' requirements for a large home range, and the existing level of human disturbance in the area, this species is not expected to use the marginal habitat in the project area. Most of the habitat that would be lost is found in areas that already experience some human disturbance (e.g., along or near existing roadways). This loss of potential marginal habitat would not have a significant impact on the species. Along segment A2 of the proposed transmission line, some habitat would be lost within the Mount Hoffman released roadless area. Because this area is largely undisturbed, it may be better-quality habitat for the wolverine. Habitat removal along segment A2 would occur along the margins of the forested portion of the roadless area and would not substantially fragment that habitat. Therefore, no significant effects on the wolverine are expected to occur as a result of the proposed project.

Mule deer (Odocoileus hemionus): About 175 acres of mule deer summer range in the Medicine Lake Highlands would be affected as a result of the proposed action. Approximately 50 acres would be lost due to construction of facilities in the wellfield and power plant area, and 125 acres along the transmission line corridor would be converted from thermal cover to foraging habitat. In addition, about 60 acres of mule deer winter range would be affected on segment C1 in the Modoc Plateau, including 50 acres of juniper woodland that may provide thermal cover for overwintering deer. This habitat loss would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available.

Oregon snowshoe hare (Lepus americanus klamathensis): Approximately 154 acres of habitat suitable for Oregon snowshoe hare would be lost due to project construction, including 50 acres at the power plant and wellfield area, and 104 acres along the transmission line corridor. This habitat loss would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available within the Medicine Lake Highlands.

Pacific fisher (Martes pennanti pacifica): Up to 128 acres of marginal habitat may be available for the Pacific fisher in the project area, but there is no evidence that this

species is present in the area, and this species is not expected to use the marginal habitat in the area. This loss of potential marginal habitat would not have a significant impact on the species.

Pronghorn (Antilocapra americana): About 63 acres of habitat suitable for pronghorn would be modified or lost due to transmission line construction on segment C1. Approximately 20 acres would be lost and 42.5 acres would be modified. The modification or loss of foraging habitat would not have a significant impact on the species, since the area affected would be only a small fraction of the total habitat available. In addition, since modification in this area would only include the existence of the transmission line, modification would not affect traditional kidding grounds used to raise young. However, loss of traditional kidding grounds habitat would be considered a significant impact.

Pronghorn using kidding grounds in shrubland or juniper woodland habitats on or adjacent to the proposed transmission corridor could be adversely affected by noise and disturbance from construction activities. Mitigation is defined to reduce impacts to levels below significance.

Sierra Nevada red fox (Vulpes vulpes necator): Approximately 250 acres of potentially-suitable habitat for the Sierra Nevada red fox exists in the wellfield and power plant area and along transmission line segments A1, A2, and B1. The specific habitat requirements of this species are not well known, so the analysis for this project assumed that all forest in red fir, lodgepole pine, and mixed conifer stands is suitable for this species. Because of the abundance of these forest types in the project area, the loss of up to 250 acres of potentially-suitable habitat is not considered significant.

Klamath sideband (Monadenia churchi): This species is found in specific landscape features within forested habitat such as limestone outcrops, caves, and talus sides. This species also uses lava rock areas and nearby woody debris. Project facilities would not be placed in or near caves, talus slides, or lava; limestone outcrops do not occur in the project area. However, project clearing may occur near rock or lava outcrops, which may disturb potential habitat for the Klamath sideband. Thus, up to 250 acres of forested habitat that in which Klamath sideband might be found would be affected by the proposed project. Although the abundance of habitat features required by this species is unknown, the project would likely affect substantially less than 250 acres of habitat for this species. This loss of this habitat would not have a significant impact on the species since it makes up a small fraction of the total forested habitat available to the species in the project area.

Oregon shoulderband (Helminthoglypta hertleini): Up to 250 acres of forested habitat that in which Oregon shoulderband might be found would be affected by the proposed project. However, this species is found in specific landscape features such as moist areas with rock fissures and large woody debris. Although the abundance of habitat features required by the Oregon shoulderband is unknown, the project would likely affect substantially less than 250 acres of habitat for this species. This loss of this habitat would not have a significant impact on the species since it makes up a small fraction of the total forested habitat available to the species in the project area.

Papillose tail-dropper (Prophysaon dubium): Up to 250 acres of forested habitat that in which Oregon shoulderband might be found would be affected by the proposed project. However, this species is found in specific landscape features such as moist areas with leaf litter and large woody debris. Although the abundance of habitat features required by the Oregon shoulderband is unknown, the project would likely affect substantially less than 250 acres of habitat for this species. This loss of habitat would not have a significant impact on the species since it makes up a small fraction of the total forested habitat available to the species in the project area.

Operational Effects: Operation of the proposed project could potentially impact certain special-status wildlife species through noise and human disturbance (see impact 4.8.2 for a discussion of noise and disturbance effects to general wildlife species). Following implementation of mitigation measures that provide restrictions on noise disturbance activities and limited operating periods, noise and disturbance effects to special-status species from operation would be reduced to levels that would be less than significant. No significant effects on wildlife migration and no interference with migration routes are expected to occur during operation.

Noise and Disturbance: Potential noise and disturbance effects could occur to northern goshawk, northern spotted owl, and bat species. No other special-status species are expected to be affected by noise and disturbance from operation of the wellfield and power plant.

Northern goshawk could be affected by noise and disturbance from operation of the wellfield and power plant, but this effect would not be considered significant. An active goshawk nest site exists in the west-central portion of the wellfield and power plant area (Grouse Hill goshawk stand). As a part of project design, well pad locations were chosen and moved away from the existing nest site to avoid this potential effect. The distance is considered to be adequate to sufficiently reduce noise and disturbance effects. No occupied goshawk nest sites are known to occur in proximity to other project facilities. Therefore, noise and disturbance effects on goshawks are not expected to be significant; however, mitigation measures are provided to further reduce any potential for impact.

As discussed under construction, previous field surveys have not identified suitable habitat for the northern spotted owl along the temporary freshwater pipeline route or the proposed transmission line route. However, some of the forested habitats within 0.25 miles of the pipeline route and segments A1 and A2 and the western portion of segment B1 of the transmission line fit the definition of suitable northern spotted owl nesting and foraging habitat, as defined by the USFS Doublehead Ranger District (Villegas 1997). The temporary pipeline would be removed during the construction phase of the project, and no effects to northern spotted owl at this location would occur during operation. Maintenance activities for the transmission line during project operation could potentially result in the disturbance of northern spotted owl in adjacent habitat.

As discussed under impact 4.8.2, noise and disturbance from construction activities would not be expected to adversely affect the use of nearby habitat by wildlife species, including bats. Normal operational noise would be less than construction noise. Normal

operational noise would therefore not adversely affect the use of nearby tree and snag roosts by special-status bat species. During infill well drilling once every two years, some displacement of special-status bat species could occur in areas adjacent to the wellpads. However, this displacement would be temporary (i.e., only during the 30-day infill drilling period), and special-status bat species would be expected to return to these areas following drilling activities. Special-status bat species would therefore not be significantly affected.

Townsend's big-eared bats are particularly sensitive to noise and human disturbance, and this type of disturbance from project operation could affect this species. Mitigation measures are identified that would identify potential roosting sites and enforce a 250-foot buffer zone around such sites. These measures would prevent impacts from project noise and ensure that this species would not be significantly affected.

Interference with Migration Routes: The existence of project facilities would not interfere with migration routes for special-status wildlife species. Roads used for project operation would not pose barriers to movement of species such as mule deer and pronghorn. Adequate space would exist under the transmission line for the free movement of wildlife species. The freshwater pipeline to Arnica Sink would be placed at grade level and would not interfere with animal movement because it would be only 4 inches in diameter. Production pipelines would be elevated approximately 3 to 6 feet above ground on stansions, and wildlife would be able to move freely underneath. Production pipeline expansion loops would be spaced approximately every 700 feet along the pipeline and would rise 18 feet above ground level and extend lengthwise for 18 feet. The injection pipelines would be located at ground level and would be approximately 12 inches in diameter; this height would allow wildlife to move freely over the injection pipeline. No significant effects on wildlife movement patterns would occur as a result of operation of these project facilities.

Decommissioning Effects: At the conclusion of the project, the removal of all structures and facilities would result in surface disturbance of areas previously impacted. Noise and human activity may temporarily displace special-status wildlife species, as described under construction. However, the ultimate effect after revegetation would be to restore habitat previously lost or degraded in quality. The impacts of conducting decommissioning activities would be similar to those for construction; there is the potential for significant impacts to occur from decommissioning. The proposed mitigation for habitat loss would apply to the decommissioning phase and would reduce effects to be less than significant. Thus, decommissioning would benefit special-status wildlife populations and their habitats in the project area.

Mitigation Measures

Mitigation Measures 4.8.1a through 4.8.1e would serve to minimize habitat loss for wildlife species (including special-status species) that would occur under the proposed project. These measures would also serve to compensate for loss of late seral stage forest and trees and snags greater than 18 inches dbh that serve as habitat for special-status species such as the northern spotted owl and several bat species.

In addition, the following mitigation measures are included to further reduce potential impacts:

4.8.3a Preconstruction surveys for certain special-status species shall be conducted prior to the commencement of construction activities to identify the actual presence of these species in potential habitat, and to identify specific areas to be avoided during project construction. Surveys shall be administered by a qualified biologist and will follow USFS protocol or other survey methodology as directed by the USFS. Surveys shall be completed for the species listed in Mitigation Measures 4.8.3b through 4.8.3l and 4.8.3p through 4.8.3r, which include the Cooper's hawk, northern goshawk, northern spotted owl, sage grouse, Swainson's hawk, pallid bat, Townsend's big-eared bat, *Myotis sp.* and silver-haired bats, American marten, and survey and manage mollusks. (C)

4.8.3b **Cooper's hawk:** During the spring of the year prior to construction and decommissioning of the transmission line, survey for active Cooper's hawk nests in a corridor extending 0.25 mile from the centerline of transmission line in potential Cooper's hawk habitat. Avoid disturbance to any active Cooper's hawk nest sites within this corridor by maintaining a limited operating period (March 1 to August 31). During this period, construction and decommissioning activities shall be prohibited within 0.25 mile of the nest site. All other forested habitats that may provide nest sites for Cooper's hawks along the transmission route proposed for this alternative have been surveyed for raptor nests and no active nests have been found in areas that would be disturbed by project construction activities. However, preconstruction surveys shall also be conducted in these areas to ensure nesting has not occurred since the last surveys were conducted. (C, D)

4.8.3c **Northern goshawk:** A limited construction and operating period shall be in effect to protect the goshawk nest site in the west-central portion of the wellfield and power plant area. This limitation will prohibit certain activities (depending on distance from the nest site) between March 1 and August 31 of each calendar year. This limitation includes no noise disturbance or habitat modifying activities within 0.25 mile of the nest site during this period (this includes limiting truck traffic on Forest Road 44N54 between March 1 and August 31 by designating an alternate route away from the goshawk nest site). This limitation also includes no habitat-modifying activities within 0.25 to 0.5 mile of the goshawk nest site during this period, but allows noise disturbance within this distance. Therefore, the following activities would be prohibited during this period within 0.25 and 0.5 mile of the goshawk nest site: (1) Construction of well pads P-4, P-5, I-2, and I-3, (2) road construction, and (3) well drilling. The testing and operation of wells at these pads would not be restricted within 0.25 and 0.5 mile of the goshawk nest site. Beyond 0.5 mile from the goshawk nest site, no restrictions on operation and construction activities will apply. In addition, all Calpine employees and contract personnel working at the site will be notified of the importance of isolating the goshawk nest site from noise and unnecessary human activity. Personnel will be prohibited from conducting field activities within 0.25 mile of the goshawk nest site unless authorized by the USFS. (C, O, D)

4.8.3d **Northern goshawk:** Preconstruction surveys shall be conducted upon identification and selection of the transmission line alignment to identify goshawk nest sites along this route and to identify specific areas where limited project-related activities would be allowed to occur. (C, D)

4.8.3e **Northern Spotted Owl:** Conduct appropriate surveys for northern spotted owl roosting or nesting habitat prior to construction of the transmission line and installation of the temporary freshwater pipeline in a corridor extending 0.25 mile from the centerline of transmission line segments in the Medicine Lake Highlands, and along the freshwater pipeline route. If there is suitable northern spotted owl roosting or nesting habitat within 0.25 mile of the freshwater pipeline and transmission line right-of-way, then no construction activity shall occur in these areas between February 1 and July 31. During annual spring maintenance, transmission line helicopter maintenance within 0.25 mile of suitable roosting or nesting habitat shall not be used. Instead,

snowmobiles or sno-cats may be used to access these portions of the transmission line for annual spring maintenance. (C, O, D)

4.8.3f **Sage grouse:** During the spring of the year prior to construction and decommissioning of the transmission line, survey the project site to determine whether or not active sage grouse strutting grounds are present. No transmission line or access road shall be constructed within 0.5 mile of a known strutting ground (as identified in CNDDB or USFS records or through preconstruction surveys). No project activities likely to create noise or disturbance shall be conducted within 0.5 mile of a known strutting ground during the spring breeding season (February 15 through April 30). (C, D)

4.8.3g **Swainson's hawk:** During the spring of the year prior to construction and decommissioning of the transmission line, survey juniper woodland habitat for active Swainson's hawk nests in a corridor extending 0.25 mile from the centerline. Avoid disturbance to any active Swainson's hawk nest sites within this corridor by maintaining a limited operating period (March 1 to July 31). During this period, construction and decommissioning activities shall be prohibited within 0.25 mile of the nest site. (C, D)

4.8.3h **Pallid bat:** Prior to construction and decommissioning of project facilities in pallid bat habitat, survey for potential diurnal roosting habitat. Also survey for potential roosting habitat within a 250-foot buffer area on either side of the transmission line corridor and along proposed access roads. Avoid removal of snags and defective trees with dbh of 18 inches or more to the greatest extent possible during construction of project facilities. All loss of snags with dbh of 18 inches or more shall be mitigated for at an off-site location at a distance of 250 feet or more from the edge of areas cleared for project facilities. (C, D)

4.8.3i **Townsend's big-eared bat:** Prior to construction and decommissioning of project facilities, survey for potential diurnal roosting habitat in the form of caves in all areas that shall be cleared or disturbed, and in a 250-foot buffer area on either side of these project facilities. When constructing project facilities, avoid impacts to caves that provide roosting habitat by enforcing a 250-foot buffer zone around these habitat features. (C, D)

4.8.3j ***Myotis sp.* and silver-haired bat species:** Prior to construction and decommissioning of project facilities, survey for potential diurnal roosting habitat in all areas that shall be cleared or disturbed and in a 250-foot buffer area on either side of these project facilities. If possible, avoid high quality roosting habitat in the form of snags and defective trees with dbh of 18 inches or more during construction of project facilities. All loss of snags with dbh of 18 inches or more shall be mitigated for off-site at a distance of 250 feet or more from the edge of areas cleared for project facilities. (C, D)

4.8.3k **American marten:** In order to minimize the potential impact to American marten using den sites within the wellfield and power plant area, all proposed facility locations shall be surveyed using the Regional Furbearer technique by a qualified biologist for log piles, hollow logs, and other suitable denning structures once during the summer and once during the winter prior to construction. Any potentially suitable marten denning structures shall be disassembled or removed slowly and watched carefully by a qualified biologist for the presence of marten. If marten are detected, activity shall cease to allow the animal to escape safely. The log piles, hollow logs, or other structures shall be reassembled at the periphery of the facility location to allow for use as potential dens. Within the wellfield and power plant area, pile and retain trees (per direction of the USFS) that are removed during construction at the periphery of the facility location to allow for use as a potential den. (C)

4.8.3l **American marten:** Along the transmission route, pile and retain trees that are removed during clearance of the 125-foot-wide corridor within marten habitat (above 5,000 feet) to allow for use as potential den structures. Provide at least four log piles (sized as directed by the USFS) along the periphery of the cleared corridor on every mile of the route through marten habitat. (C)

4.8.3m **Mule deer:** No construction or decommissioning activities shall be allowed from December 1 through March 31 (adjusted by the USFS as necessary to

ensure the intent of the seasonal restriction) on mule deer winter range. Wildlife "guzzlers" shall be placed in mule deer summer range to enhance habitat.(C, D)

4.8.3n **Pronghorn:** When constructing the transmission line through pronghorn habitat, avoid or minimize surface disturbance in known kidding grounds (as defined in CNDDB and/or USFS records). During the period between May 1 to June 31 (adjusted by the USFS as necessary to ensure the intent of the seasonal restriction), construction and decommissioning activities shall be prohibited within 0.25 mile of the kidding ground. (C, D)

4.8.3o In order to eliminate the chance of wildlife coming in contact with geothermal fluids that are temporarily and infrequently present in the sumps, netting or other protective measures (as agreed to by the USFWS) will be placed over each sump and fencing will be placed around the perimeter of the sumps. If netting is used, the netting material and mesh size will be sufficient to prevent birds or bats from contacting the contents of the sump but not to trap birds or bats in the netting itself. (C, O)

4.8.3p **Oregon shoulderband:** Prior to construction and decommissioning of project facilities, survey potential habitat according to the survey protocol for terrestrial mollusks in the Northwest Forest Plan. When constructing project facilities and when possible, avoid impacts to important habitat features such as rocky outcrops or slides, rocky fissures, or large woody debris when possible.

4.8.3q **Papillose tail-dropper:** Prior to construction and decommissioning of project facilities, survey potential habitat according to the survey protocol for terrestrial mollusks in the Northwest Forest Plan. When constructing project facilities and when possible, avoid impacts to important habitat features such as areas of extensive leaf litter and large woody debris.

4.8.3r **Klamath sideband:** Prior to construction and decommissioning of project facilities, survey potential habitat according to the survey protocol for terrestrial mollusks in the Northwest Forest Plan. When constructing project facilities and when possible, avoid impacts to important habitat features such as rock outcroppings, lava rockslides, and large woody debris.

Level of Significance After Mitigation

Less than significant.

4.8.4 Bird Electrocution and Collision Hazards

Construction and operation of the proposed project could pose the potential for birds to be electrocuted and/or collide into transmission lines. This is not anticipated to result in significant impacts. However, if a special-status species is involved, the impact could be considered significant; therefore, mitigation measures have been incorporated to avoid this potential impact. After mitigation, this effect would be a less-than-significant impact.

Construction: Construction of the proposed project would involve the development of a transmission line that would span a distance of approximately 25 miles and would include a transmission line support structures up to 60 to 80 feet height. Construction activities in and of themselves would not pose an impact to birds from electrocution or collision. The potential for birds to collide with transmission line wires is discussed below under Operation.

Operation: Bird collisions with transmission line wires would be a potential hazard, especially under conditions of low visibility or high levels of bird flight activity. While collisions with the large diameter conductors are relatively unlikely because of their

visibility, the small diameter (3/8 inch) overhead ground wires are less visible and birds may strike them while avoiding conductors. Birds that collide with wires may be crippled or killed; this would be considered a significant adverse impact if it involved listed or other special-status species. The highest potential for bird collisions exists along the portion of segment A1 located near Medicine Lake. The special-status species most active in this area are bald eagles and ospreys. However, raptors such as the bald eagle and osprey are unlikely to be affected by transmission lines because of their high maneuverability in flight. (Avian Power Line Interaction Committee 1994).

The transmission line would not pose an electrocution hazard to flying or perching birds since the separation of energized conductors would be at least 18 feet apart, which would far exceed the recommended minimum spacing of 60 inches (Heidecke 1996; Avian Power Line Interaction Committee 1996).

Decommissioning: No impact is anticipated to occur at the time of decommissioning activities because transmission lines would be removed. The project site would be returned to pre-project conditions, and would not pose any potential threat to birds. Therefore, no impact would occur.

Mitigation Measures

Bird collisions could be considered significant if special status species are involved. Therefore, the following mitigation measure is included to reduce this potential impact to a less-than-significant level:

4.8.4a Overhead ground wires and conductors should be placed at or below the surrounding forest canopy wherever possible. As directed by the USFS, marking devices will be installed along segment C1 or C2 (where greater sandhill cranes may be active). Marking devices could include aerial marker spheres, spiral vibration dampers, or bird flight diverters. (C)

Level of Significance After Mitigation

Less than significant.

ALTERNATIVES

As discussed at the beginning of this chapter, the following describes potential effects and recommended mitigation measures for each alternative to the proposed action. Alternatives to the proposed action include various alternate transmission line routes (Alternatives 2 through 6) and the No Action alternative (Alternative 7).

For Alternatives 2 through 6, potential impacts associated with the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of potential impacts along these portions of the transmission line are not repeated under each alternative discussion. The analysis of these impacts focuses on the effects that would be different from those identified for the proposed action and references are provided for those segments that have been previously discussed under the proposed action or a preceding alternative discussion.

Alternative 2 (Segments A1, A2, B1, and C2)

Alternative 2 differs from the proposed action by the substitution of transmission line segment C2 for segment C1 and a correspondingly different location of the substation at the end of the transmission line. Alternative 2 would have the same effects as the proposed action for the construction, operation, and decommissioning of the power plant, wellfield, and segments A1, A2, and B1 of the transmission line. This alternative would avoid any impacts caused by construction of segment C1 of the proposed transmission line, but would add impacts caused by construction of segment C2.

Potential for General Wildlife Habitat Loss: Habitat loss due to construction of the wellfield and power plant facilities and the freshwater pipeline to Arnica Sink would be identical to that described for Alternative 1 and is not considered a significant adverse impact to wildlife. Construction of the transmission line would affect a total of 343.2 acres of general wildlife habitat, including the removal of 125.7 acres of wildlife habitat, 143.0 acres of habitat conversion, and the disturbance of 74.5 acres (see Table 4.7-2 for specific vegetation community types). Of the affected habitat, only 125.7 acres of removed habitat would be considered a loss of general wildlife habitat.

Lodgepole pine forest would be the habitat that would be most affected by construction of the transmission line under this alternative, followed by upper montane mixed conifer forest, ponderosa pine forest, and lower montane mixed conifer forest. Late seral stage red fir forest makes up about 8 percent of total habitat loss in this alternative, or 20.7 acres. Habitat loss from transmission line construction would not result in a significant adverse impact to wildlife, because it would primarily affect habitat types that are common and widespread in the region.

Mitigation Measures 4.8.1a through 4.8.1e, identified for the proposed action, would also apply to Alternative 2. After mitigation, the impacts of habitat loss on general wildlife resources would be less than significant.

Wildlife Effects from Noise and Disturbance: Impacts of noise and human disturbance during construction, operation, and decommissioning of Alternative 2 would be the same as those described for the proposed action. No significant impacts to general wildlife would result from noise and disturbance during any of the phases of Alternative 2. Mitigation Measure 4.8.2a, identified for the proposed action, would also apply to Alternative 2.

Effects on Special-Status Species: As with the proposed action, Alternative 2 could have the potential to affect special-status species through loss of habitat, noise and human disturbance associated with project activities, and interference with migration routes. The effects and level of significance under Alternative 2 of noise and human disturbance and interference with migration routes would be generally the same as for the proposed action.

Table 4.8-3 identifies the amount of habitat that would be lost for each special-status species under Alternative 2. These species would experience approximately the same amount of habitat loss under Alternative 2 as under the proposed action. For the same

Table 4.8-3: Special-Status Species Habitat Loss For Each Alternative (in Acres)

Species	Alt.1[1]	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Birds						
Bald eagle[2]	0	0	0	0	0	0
Blue grouse[4]	128	128	110	110	117	117
Cooper's hawk[4]	154	154	137	137	143	143
Golden eagle[4]	175	173	158	156	164	162
Great gray owl[2]	<2	<2	<2	<2	0	0
Greater sandhill crane	0	0	0	0	0	0
Hairy woodpecker[3]	245	244	246	245	233	232
Loggerhead shrike[2]	20	14	20	14	20	14
Northern goshawk[4]	154	154	137	137	143	143
Northern spotted owl[3]	77	77	62	62	66	66
Osprey[2]	0	0	0	0	0	0
Pileated woodpecker[3,5]	243	243	170	170	231	231
Sage grouse[2]	12	14	12	14	12	14
Swainson's hawk[2]	20	19	20	19	20	19
Bats						
Fringed Myotis[4]	175	173	158	156	164	162
Long-Eared Myotis[4]	154	154	137	137	143	143
Long-Legged Myotis[4]	154	154	137	137	143	143
Pallid Bat[4]	175	173	158	156	164	65
Silver-Haired Bat[4]	154	154	137	137	143	143
Spotted Bat[2]	0	0	0	0	0	0
Townsend's Big-eared Bat[4]	175	173	158	156	164	162
Western Mastiff Bat[2]	0	0	0	0	0	0
Western Small-Footed Myotis	67	65	79	78	67	65
Other Mammals						
American badger[2]	20	19	20	19	20	19
American marten[4]	128	128	110	110	117	117
California wolverine[3,4]	250	253	238	238	241	241
Mule deer (summer/winter)[4]	175	173	158	156	164	162
Oregon snowshoe hare[4]	154	154	110	110	143	143
Pacific fisher[4]	128	128	110	110	117	117
Pronghorn[2]	20	19	20	19	20	19
Sierra Nevada red fox[3,4]	250	253	238	238	241	241
Invertebrates						
Klamath sideband[3,4,6]	250	253	238	238	241	241
Oregon shoulderband[3,4,6]	250	253	238	238	241	241
Papillose tail-dropper[3,4,6]	250	253	238	238	241	241

Notes:

1 Alternative 1 is the Proposed Action; all alternatives include the power plant and wellfield, temporary freshwater pipeline, and transmission line.

2 Little or no suitable habitat would be lost for this species.

3 All acreage converted from forest to shrub/herb counted as direct habitat loss for this species.

4 Acreage for this species includes 50 acres of habitat loss at the wellfield and power plant area.

5 Acreage for this species includes 3 acres of habitat loss at the wellfield and power plant area.

6 This species is associated with certain features within forested habitat such as rocky outcrops and patches of large woody debris; the abundance of these features within forested habitat in the project area is unknown, so the analysis assumes that these features occur throughout appropriate forested habitat within the project area.

SOURCE: Leitner 1997; USFS 1998

reasons discussed under Alternative 1, the effects of habitat loss and disturbance to special-status species under Alternative 2 would be potentially significant for certain special status wildlife species. Mitigation Measures 4.8.3a through 4.8.3n, identified for the proposed action, would also apply to Alternative 2. After mitigation, the impacts on special status wildlife species would be less than significant.

Bird Electrocution and Collision Hazards: The potential for bird electrocution or collision hazards associated with the transmission line would be the same under this alternative as the proposed action, and Mitigation Measure 4.8.4a for this potential effect would apply to this alternative.

Alternative 3 (Segments A1, B2, and C1)

Alternative 3 differs from the proposed action by the substitution of transmission line segment B2 for segments A2 and B1. This transmission line route would extend south of Red Shale Butte and Lyon's Peak before heading north to connect with segment C1. Alternative 3 would have the same effects as the proposed action for the construction, operation, and decommissioning of the power plant, wellfield, and segments A1, and C1 of the transmission line. This alternative would avoid any impacts caused by construction of segments A2 and B1 of the proposed transmission line, but would add impacts caused by construction of segment B2.

Potential for General Wildlife Habitat Loss: Habitat loss due to construction of the wellfield and power plant facilities and the freshwater pipeline to Arnica Sink would be identical to that described for Alternative 1 and is not considered a significant adverse impact to wildlife. Wildlife habitat that would be affected by construction of the transmission line and substation would total approximately 390.5 acres (see Table 4.7-2). Of this total, 110.5 acres of habitat would be removed, 154.0 acres of habitat conversion would occur, and 126.0 acres would be disturbed. The 110.5 acres of habitat that would be removed under this alternative would be considered a loss of general wildlife habitat.

Mitigation Measures 4.8.1a through 4.8.1e, identified for the proposed action, would also apply to Alternative 3. After mitigation, the impacts of habitat loss on general wildlife resources would be less than significant.

Wildlife Effects from Noise and Disturbance: Impacts of noise and human disturbance during construction, operation, and decommissioning of Alternative 3 would be the same as those described for the proposed action. No significant impacts to general wildlife would result from noise and disturbance during any of the phases of Alternative 3. Mitigation Measure 4.8.2a, identified for the proposed action, would also apply to Alternative 3.

Effects on Special-Status Species: Alternative 3 could have the potential to affect special-status species through loss of habitat, noise and human disturbance associated with project activities, and interference with migration routes. The effects and level of significance under Alternative 3 of noise and human disturbance and interference with migration routes would be generally the same as for the proposed action. However, use of Alternative 3 would include segment B2, which would result in the loss of late seral

forest habitat in the Medicine Lake Highlands MLSA. Loss of this habitat would result in a greater affect on special-status species than the proposed action.

Under Alternative 3, most special-status species would experience the same amount or slightly less habitat loss than under the proposed project (see Table 4.8-3). For the same reasons discussed under Alternative 1, the effects of habitat loss and disturbance to special-status species under Alternative 3 would be potentially significant for certain special status wildlife species. Mitigation Measures 4.8.3a through 4.8.3n, identified for the proposed action, would also apply to Alternative 3. After mitigation, the impacts on special status wildlife species would be less than significant.

Bird Electrocution and Collision Hazards: The potential for bird electrocution or collision hazards associated with the transmission line would be the same under this alternative as the proposed action, and Mitigation Measure 4.8.4a for this potential effect would apply to this alternative.

Alternative 4 (Segments A1, B2, and C2)

Alternative 4 would be similar to Alternative 3 except that it would follow segment C2 north to avoid Tionesta, rather than following segment C1. Alternative 4 would have the same effects as the proposed action for the construction, operation, and decommissioning of the power plant, wellfield, and segment A1 of the transmission line. This alternative would avoid any impacts caused by construction of segments A2, B1, and C1 of the proposed transmission line, but would add impacts caused by construction of segments B2 and C2.

Potential for General Wildlife Habitat Loss: Habitat loss due to construction of the wellfield and power plant facilities and the freshwater pipeline to Arnica Sink would be identical to that described for Alternative 1 and is not considered a significant adverse impact to wildlife. Wildlife habitat that would be affected by construction of the transmission line and substation would total approximately 395.1 acres (see Table 4.7-2). Of this total, 108.7 acres of habitat would be removed (and therefore would be considered loss of general wildlife habitat), approximately 161.1 acres of habitat conversion would occur, and about 125.3 acres of habitat disturbance would occur.

Ponderosa pine forest and upper montane mixed conifer forest would be the habitats that would be most affected by construction of the transmission line under this alternative, followed by lodgepole pine forest and lower montane mixed conifer forest.

This amount of habitat loss would not result in a significant adverse impact to wildlife, because it would primarily affect habitat types that are common and widespread in the region.

Mitigation Measures 4.8.1a through 4.8.1e, identified for the proposed action, would also apply to Alternative 4. After mitigation, the impacts of habitat loss on general wildlife resources would be less than significant.

Wildlife Effects from Noise and Disturbance: Impacts of noise and human disturbance during construction, operation, and decommissioning of Alternative 4 would be the same as those described for the proposed action. No significant impacts to general wildlife would result from noise and disturbance during any of the phases of

Alternative 4. Mitigation Measure 4.8.2a, identified for the proposed action, would also apply to Alternative 4.

Effects on Special-Status Species: Alternative 4 could have the potential to affect special-status species through loss of habitat, noise and human disturbance associated with project activities, and interference with migration routes. The effects and level of significance under Alternative 4 of noise and human disturbance and interference with migration routes would be generally the same as for the proposed action. However, use of Alternative 4 would include segment B2, which would result in the loss of late seral forest habitat in the Medicine Lake Highlands MLSA. Loss of this habitat would result in a greater affect on special-status species than the proposed action.

Under Alternative 4, most special-status species would experience the same amount or slightly less habitat loss than under the proposed project (see Table 4.8-3). For the same reasons discussed under Alternative 1, the effects of habitat loss and disturbance to special-status species under Alternative 4 would be potentially significant for certain special status wildlife species. Mitigation Measures 4.8.3a through 4.8.3n, identified for the proposed action, would also apply to Alternative 4. After mitigation, the impacts on special status wildlife species would be less than significant.

Bird Electrocution and Collision Hazards: The potential for bird electrocution or collision hazards associated with the transmission line would be the same under this alternative as the proposed action, and Mitigation Measure 4.8.4a for this potential effect would apply to this alternative.

Alternative 5 (Segments A3, B1, and C1)

Alternative 5 differs from the proposed action by the substitution of transmission line segment A3 for segments A1 and A2. Segment A3 extends north from the power plant, passing to the west of Fourmile Hill. This segment then extends east following a route to the north of Mt. Hoffman. Alternative 5 would have the same effects as the proposed action for the construction, operation, and decommissioning of the power plant, wellfield, and segments B1 and C1 of the transmission line. This alternative would avoid any impacts caused by construction of segments A1 and A2 of the proposed transmission line, but would add impacts caused by construction of segment A3.

Potential for General Wildlife Habitat Loss: Habitat loss due to construction of the wellfield and power plant facilities and the freshwater pipeline to Arnica Sink will be identical to that described for Alternative 1 and is not considered a significant adverse impact to wildlife. Wildlife habitat loss that would be affected by construction of the transmission line and substation would total approximately 325.4 acres (see Table 4.7-2). Of this total, about 116.8 acres of habitat would be removed (i.e., lost), approximately 135.0 acres of habitat would be converted, and about 74.6 acres of habitat would be disturbed.

Construction of the transmission line would result in the greatest habitat loss in upper montane mixed conifer forest and lodgepole pine forest, followed by ponderosa pine forest, lower montane mixed conifer forest, and ponderosa pine plantation. This amount of habitat loss would not result in a significant adverse impact to wildlife, because it would affect only habitat types that are common and widespread in the

region. The transmission line corridor would be located below late seral areas, on the border of high quality late seral areas and low quality logged areas.

Mitigation Measure 4.8.1a through 4.8.1e, identified for the proposed action, would also apply to Alternative 5. After mitigation, the impacts of habitat loss on general wildlife resources would be less than significant.

Wildlife Effects from Noise and Disturbance: Impacts of noise and human disturbance during construction, operation, and decommissioning of Alternative 5 would be the same as those described for the proposed action. No significant impacts to general wildlife would result from noise and disturbance during any of the phases of Alternative 5. Mitigation Measure 4.8.2a, identified for the proposed action, would also apply to Alternative 5.

Effects on Special-Status Species: Alternative 5 could have the potential to affect special-status species through loss of habitat, noise and human disturbance associated with project activities, and interference with migration routes. The effects and level of significance under Alternative 5 of noise and human disturbance and interference with migration routes would be generally the same as for the proposed action.

Under Alternative 5, most special-status species would experience the same amount or slightly less habitat loss than under the proposed project (see Table 4.8-3). For the same reasons discussed under Alternative 1, the effects of habitat loss and disturbance to special-status species under Alternative 5 would be potentially significant for certain special status wildlife species. Mitigation Measures 4.8.3a through 4.8.3n, identified for the proposed action, would also apply to Alternative 5. After mitigation, the impacts on special status wildlife species would be less than significant.

Bird Electrocution and Collision Hazards: The potential for bird electrocution or collision hazards associated with the transmission line would be the same under this alternative as the proposed action. However, since the transmission line would not pass through the vicinity of Medicine Lake (an area with high levels of bald eagle and osprey flight activity) under this alternative, the potential for these special-status bird to collide with the transmission line would be reduced. Mitigation Measure 4.8.4a for this potential effect would apply to this alternative.

Alternative 6 (Segments A3, B1, and C2)

Alternative 6 is similar to Alternative 5 except that it follows segment C2 north to avoid Tionesta, rather than following segment C1. Alternative 6 would have the same effects as the proposed action for the construction, operation, and decommissioning of the power plant, wellfield, and segment B1 of the transmission line. This alternative would avoid any impacts caused by construction of segments A1, A2, and C1 of the proposed transmission line, but would add impacts caused by construction of segments A3 and C2.

Potential for General Wildlife Habitat Loss: Habitat loss due to construction of the wellfield and power plant facilities and the freshwater pipeline to Arnica Sink will be identical to that described for Alternative 1 and is not considered a significant adverse impact to wildlife. Wildlife habitat that would be affected by construction of the transmission line and substation would total approximately 330.8 acres (see Table 4.7-2).

Of this total, 114.9 acres of habitat would be removed (i.e., lost), approximately 142.1 acres of habitat would be converted, and about 73.8 acres of habitat would be disturbed.

Construction of the transmission line under Alternative 6 would result in the greatest habitat loss in upper montane mixed conifer forest and lodgepole pine forest. Habitat loss would also occur in ponderosa pine forest, lower montane mixed conifer forest, big sage brush, and ponderosa pine plantation. This amount of habitat loss would not result in a significant adverse impact to wildlife, because it would affect only habitat types that are common and widespread in the region.

Mitigation Measure 4.8.1a through 4.8.1e, identified for the proposed action, would also apply to Alternative 6. After mitigation, the impacts of habitat loss on general wildlife resources would be less than significant.

Wildlife Effects from Noise and Disturbance: Impacts of noise and human disturbance during construction, operation, and decommissioning of Alternative 6 would be the same as those described for the proposed action. No significant impacts to general wildlife would result from noise and disturbance during any of the phases of Alternative 6. Mitigation Measure 4.8.2a, identified for the proposed action, would also apply to Alternative 6.

Effects on Special-Status Species: Alternative 6 could have the potential to affect special-status species through loss of habitat, noise and human disturbance associated with project activities, and interference with migration routes. The effects and level of significance under Alternative 6 of noise and human disturbance and interference with migration routes would be generally the same as for the proposed action.

Under Alternative 6, most special-status species would experience the same amount or slightly less habitat loss than under the proposed project (see Table 4.8-3). For the same reasons discussed under Alternative 1, the effects of habitat loss and disturbance to special-status species under Alternative 6 would be potentially significant for certain special status wildlife species. Mitigation Measures 4.8.3a through 4.8.3n, identified for the proposed action, would also apply to Alternative 6. After mitigation, the impacts on special status wildlife species would be less than significant.

Bird Electrocution and Collision Hazards: The potential for bird electrocution or collision hazards associated with the transmission line would be the same under this alternative as the proposed action. However, since the transmission line would not pass through the vicinity of Medicine Lake (an area with high levels of bald eagle and osprey flight activity) under this alternative, the potential for these special-status bird to collide with the transmission line would be reduced. Mitigation Measure 4.8.4a for this potential effect would apply to this alternative.

Alternative 7 (No Action)

There would be no impacts to general wildlife resources or special-status wildlife species under Alternative 7, the No Action alternative. No mitigation measures would be necessary.

4.9 Visual Quality

INTRODUCTION

This section provides a visual resource evaluation of construction, operation, and decommissioning of the proposed action (Alternative 1) and alternatives. This evaluation is based on an assessment of visible project elements from surrounding Key Observation Points (KOPs) in the region, as defined and described in Section 3.9. The visibility and visual resource effects of the project on Traditional Cultural Values are described and evaluated in Section 4.6.

KEY ISSUES

The key visual issues identified and evaluated in this section relate to the effects of the project on views from Medicine Lake, Tionesta, and Lava Beds National Monument. These effects are evaluated in Impacts 4.9.5, 4.9.8, and 4.9.9. Another key issue relates to the effects of transmission line crossings. These effects are evaluated in Impact 4.9.4 (Medicine Lake area roads) and Impact 4.9.8 (Tionesta area roads).

SIGNIFICANCE CRITERIA

In accordance with CEQA Guidelines, a project impact would be considered significant if development would:

- Eliminate or substantially alter significant visual features, view corridors, or public vista points
- Result in substantial alteration of natural landforms
- Be incompatible with the scale or visual character of the surrounding area
- Create significant new sources of light and glare in the vicinity

In accordance with USFS visual assessment practices, project impacts would also be considered significant to visual quality if:

- A project condition results in a long-term inconsistency with established USFS Visual Quality Objectives (VQOs)
- The project would create a high level of visual contrast as related to spatial characteristics, visual scale, texture, form, line, and color as viewed from KOPs
- The project and proposed mitigation measures would not meet a Retention and Partial Retention VQO within three years of project completion

In accordance with the NPS visual resource policies, if any visual intrusion related to the proposed project would be perceived by visitors in the Lava Beds National Monument's two wilderness areas, the quality of the wilderness would be considered to be adversely affected.

METHODOLOGY

Visual Analysis

Project effects on regional visual resources are evaluated by KOP or by KOP groupings that are located in a particular area. There are several instances where views from forest

roads, which are not identified KOPs, are also evaluated due to their proximity to the proposed action.

At each KOP, the existing visual setting and the siting of the wellfield, power plant, and transmission line route and alternatives have been evaluated in terms of the potential impacts on scenic quality and the viewer's experience. The assessment of the likely visibility of facilities in the landscape was based on a line-of-sight analysis from KOPs as identified and described in Section 3.9. The overall visual effect and significance of visible project features were evaluated and described according to guidelines for identifying significant visual contrast and changes in the integrity of the existing landscape character.

The degree to which a project or activity affects the visual quality of a landscape depends on the visual contrast created between the project components and the integrity of the existing landscape character. The amount of contrast that would be created by the proposed project elements was assessed by first considering the existing characteristic landscape by major features (e.g. land forms, vegetation patterns and diversity, soil color, snow conditions, and structures), and then predicting the magnitude of change that would occur with project implementation. The change in these landscape features is evaluated in terms of the basic visual elements (e.g. form, line, color, and texture) that already exist in the landscape and the degree to which these landscape elements would be modified by facilities of the proposed action and alternatives.

Additional criteria used to evaluate the degree of visual contrast as seen from KOPs were scale and spatial dominance. The scale of the proposed activities was compared to the scale of the entire landscape setting and placement of the activities in the viewshed. Spatial dominance was analyzed using criteria that included the complexity of the landscape composition, degree of natural screening by vegetation and landforms, view aspect and orientation of the KOP, backdrop conditions, lighting conditions, seasonal effects, view distance, and duration of view.

Visible project features were evaluated for their consistency with USFS VQOs, as identified and defined in Section 3.9. This analysis is based on an assessment of whether the proposed action and alternatives would result in long-term inconsistencies with VQOs. This assessment is based primarily on whether the visibility of project features as seen from KOPs would occur consistently over the long term. For example, construction effects would not occur over the long term, whereas, the presence of the transmission line facility would occur over the life of the project. In addition to evaluating VQO consistency from KOPs, an on-the-ground analysis has also been conducted to determine whether project features would result in inconsistencies with VQOs in areas that cannot be seen from KOPs.

In addition to the analyses of views from KOPs, the potential effect of the project on views from other locations such as nearby roads has also been analyzed. This more general visual analysis is provided for an evaluation of the project's overall visual effect on the typical forest user. This analysis was conducted in a similar manner as the KOP analysis, and also considered frequency of exposure to the project.

Visual Simulations

Overview: To aid in the characterization of visual impacts, photo-simulations have been prepared for this analysis. The purpose of the photo-simulations is to approximate the anticipated long-term appearance of the proposed action and alternatives in the existing landscape, prior to mitigation.

Visual simulations of proposed action facilities and facilities that would occur with proposed alternatives, were prepared for 5 of the 21 KOPs identified in Section 3.9. The 5 KOPs were selected based on input from the NPS, the Modoc and Klamath National Forests, and the public during the public scoping period. These KOPs are intended to provide a range of view perspectives of the proposed action and alternatives from key public viewing locations within the study area, and include:

- KOP #2–Medicine Lake Recreation Area/Boat Launch
- KOP #3–Medicine Lake Recreation Area/Medicine Lake
- KOP #8–Primary Forest Route 49/Medicine Lake Overlook
- KOP #13–Primary Forest Route 97
- KOP #20–Lava Beds National Monument/Schonchin Butte

Method for Simulating Project Facilities: Visual simulations were conducted to depict project facilities and features in daylight hours during the summer, as this is when the area receives the greatest visitor use. These features include cooling tower steam plumes and the proposed and alternative transmission line facilities and associated right-of-way. The simulations of these features were prepared using the methods identified below.

Cooling Tower Steam Plumes: The steam plumes were plotted by first estimating the location of the power plant site. This was accomplished by measuring angles and distances from selected control points (buttes, craters, significant breaks in topography, ridgelines, etc.) as shown on the 7.5 minute USGS quadrangle series and triangulating its location as seen from the KOP. The overall height of the steam plume was estimated based on the height of ridgeline trees and the assumption that the plume would extend approximately 110 feet in height above the cooling tower and 375 feet in length. The height refers to the vertical height of the visible plume above the cooling tower and the length refers to the horizontal length of the plume trailing which typically extends in the direction that the wind blows. The simulation of heights took into account topographic elevation of the power plant site and the height of the cooling tower.

Transmission Line: The transmission line route alignment and support structure spacing were plotted by measuring angles and distances from selected control points (buttes, craters, significant breaks in topography, ridgelines, etc.) as shown on the 7.5 minute USGS quadrangle series. The proportional method of three-dimensional delineation was employed for plotting locations. Overall alignments were also compared and verified against wire-frame CAD printouts supplied by the project applicant.

Heights of support structures were based on a comparison against the height of the adjacent forest canopy. In the immediate Medicine Lake area, the top of the forest canopy is between approximately 50 feet and 60 feet high. At the power plant, the average forest canopy is between approximately 40 feet and 50 feet high. There is

gradation in average forest canopy height between the power plant site and the Medicine Lake area.

Relevant Project Characteristics and Assumptions

The elements of the proposed action and alternatives that can be visible from surrounding locations relate primarily to the presence of well venting and cooling tower steam plumes, facility night lighting, and the transmission line. The characteristics and assumptions of these project elements that are relevant to the visual analysis contained in this section, are identified briefly below.

Steam Plume Assumptions: The evaluation of the visibility and visual effects of well venting and cooling tower steam plumes is based on the assumptions identified below regarding winter and summer plume size and atmospheric effects. This information is based on analysis completed for the Newberry Geothermal Pilot Project, which is located in a setting similar to the Medicine Lake Highlands (USFS et al. 1994).

Visibility of Steam Plumes: The size and visibility of steam plumes are primarily related to ambient temperature and the resulting significant differences in evaporation rates. On hot, dry days with high evaporation rates, steam plumes may not be visible because higher ambient temperatures result in plumes that are less dense (opaque) and less visible. Steam plumes are typically most evident on cold days with lower evaporation rates, resulting in plumes that are more dense and, therefore, more visible. Regardless of the ambient temperatures, variations in atmospheric pressure and wind conditions can make the visibility of steam plumes ephemeral, due to dispersion.

As a result of the periodic presence and ephemeral nature of steam plumes, the visual analysis assumes that the visibility of steam plumes, during both construction and operation, would not result in potential long-term inconsistencies with USFS VQOs. Many forest visitors and residents may not readily distinguish steam plumes from clouds or other atmospheric features that may be experienced in the Medicine Lake area. These include clouds, fog emanating over the lake, regional fog and low cloud cover, rain squalls and storms, and snow storms.

Well Venting Steam Plumes: It is anticipated that well venting as a result of flow testing would occur once well drilling is completed for a particular well and would last as long as six weeks, although more typically about two weeks. Well venting steam plumes can result during this process. The height of well venting plumes could range from 40 feet during the summer, to 285 feet during the winter. Unless otherwise stated, the summer well venting plumes would not be visible from surrounding locations due to the forest tree cover, which is an average of approximately 45 feet at the wellfield.

Well venting steam plumes would be present primarily during the first two years of construction when the majority of wells are drilled and tested. These steam plumes could also result during flow testing of infill wells, drilled periodically during operation of the project.

Cooling Tower Steam Plumes: Cooling tower steam plumes, generated during the operation of the power plant, could be expected to extend above the cooling tower an additional 110 feet in height and 375 feet in length. During winter, the average plume height could be expected to extend 250 feet above the cooling tower, with a length of

930 feet. As a result of this height, cooling tower steam plumes could be visible year round, depending on atmospheric conditions. As noted above, plume visibility is typically ephemeral, due to dispersion, and plumes are less visible in summer as they are less dense, due to higher ambient temperatures.

Lighting Assumptions: The evaluation of the visibility and visual effects of drill rig and power plant facility lighting is based on project information provided by Calpine Corporation and identified below.

Drill Rig Mast Lighting: Lighting would be along the full length of drill rig masts, anticipated to be 140- to 145-feet tall. Drill rigs are typically operated on a 24-hour basis when in use.

Power Plant Facility Lighting: The turbine building would extend approximately 45 feet above the forest canopy, but would not require exterior lighting except at the lower levels for ground access. The cooling tower which would include exterior lights for stairway access to the facility, would project above the forest canopy. Most perimeter and area lights and the more brilliant switchyard lighting would be positioned at the upper levels of the forest canopy where branching density and associated screening potential are reduced.

Transmission Line: The typical height and design of support structures for the proposed transmission line are described in Chapter 2 of this document. To reduce reflection and glare, only non-specular conductors would be used, as planned by Calpine. Vegetation clearance within the transmission line right-of-way are also described in Chapter 2. Vegetation clearance assumptions developed for this project are identified below. Assumptions are provided for three subareas within the project vicinity that have definite topographic and vegetation characteristics, to provide a realistic estimate of likely vegetation clearance along the transmission line right-of-way. Figure 2.2-10 provides a schematic illustration of how the transmission line right-of-way clearance is likely to look in forested landscapes.

- Highland — Extends from the start of the transmission line at the plant site to the Siskiyou/Modoc county line
  - Primarily forested with large trees
  - 50-foot swath would be cleared at a minimum
  - Theoretically, the remaining 37.5 feet on each side could be scalloped; however, because of the large size of the trees, most of it would end up being cleared
  - Therefore, it was assumed that 100 feet of the vegetation would be cleared, with 12.5 feet on each side being scalloped
- Transition — Extends from Siskiyou/Modoc county line to the COTP line
  - Primarily forested, but trees not as large as in the highlands
  - 50-foot swath would be cleared
  - Remaining 37.5 feet on each side would be scalloped
- Plateau — Extends from the COTP line to the substation at the end of the transmission line
  - Primarily shrub/grassland with varying densities of ponderosa pine and juniper forest cover

- In many areas only transmission structure sites would have to be cleared

PROPOSED ACTION (ALTERNATIVE 1)

Overview

The effects of the proposed action on views and visual resources, as seen from specific locations and KOPs are evaluated for:

- The wellfield and power plant vicinity (Forest Roads 44N54 and 44N64)
- Primary Forest Route 49 (KOP 7)
- Medicine Lake Area Roads (KOPs 8-10)
- Medicine Lake Recreation Management Area (KOPs 1-5)
- Little Mount Hoffman (KOP 6)
- Arnica Sink and Glass Mountain (KOPs 11 and 12)
- The Tionesta area (KOPs 13-17)
- Lava Beds National Monument (KOPs 18-21)

Key visual quality effects of the proposed action are related to the visibility of wellfield and power plant facilities, occasional presence of steam plumes, night lighting of the wellfield and power plant facilities, and visibility of the transmission line and cleared right-of-way. The majority of these visual effects can be mitigated to a less-than-significant level through a combination of detailed site planning, facility design, materials selection, revegetation programs, and minor adjustments to the routing of the transmission line.

Visual quality impacts that can not be mitigated to a less than significant level involve changes to the integrity of the landscape character made by the proposed transmission line and cleared right-of-way between mileposts 0.6 and 3.3 as seen from Forest Road 49 (KOP 8), Medicine Lake (KOP 3), the Medicine Lake day use recreation areas along the Lake's eastern shoreline (KOP 2), the Medicine Lake Lava Flow trail (KOP 4), and private recreation residences on the south side of the lake (KOP 5). Impacts 4.9.4 and 4.9.5 describe these effects.

The proposed action would result in six crossings of inventoried sensitive routes of travel, including: Primary Forest Routes 77, 49, 10, and 97; Forest Road 44N01; and State Highway 139. With the exception of Primary Forest Route 77, the visual impacts of these road crossings could be mitigated to a less-than-significant level. The visual quality impact of the transmission line crossing of Primary Forest Route 77, associated with Segment A, would result in a significant unavoidable impact. Impacts 4.9.4 and 4.9.8 describe these effects.

Table 4.9-1 provides a summary of the features of the proposed action that would be visible from each of the KOPs. Included are existing VQOs as outlined in the Modoc and Klamath LRMPs, an evaluation of current VQO conditions as seen from each KOP, and a prediction of future VQO conditions with mitigation of the project.

4.9.1 Temporary Visual Effects of Vehicles and Equipment

The temporary visual effect of vehicles and equipment on forest roads during construction and decommissioning of the project would be a short-term adverse, but

Table 4.9-1: Summary of Visual Quality Effects from KOPs

KOP #	Location	VQO [1]	Existing Visual Condition[2]	Wellfield and Power Plant Facilities[3]	Steam Plumes[4]	Lighting[5]	Transmission Line[6]	VQO Achievement Without Mitigation	VQO Achievement After Mitigation
1	Medicine Lake Recreation Area: Hogue Campground Shoreline	R	PR	Not Visible	Not Visible	Not Visible	Not Visible	NA	NA
2	Medicine Lake Recreation Area: Boat Launch	R & PR	R & PR	Not Visible	Visible	Not Visible	Visible	Not Consistent	Consistent - PR
3	Medicine Lake Recreation Area: Medicine Lake	R & PR	R & PR	Not Visible	Visible	Not Visible	Visible	Not Consistent	Consistent - PR
4	Medicine Lake Recreation Area: Medicine Lake Lava Flow Trail	PR	R	Not Visible	Not Visible	Not Visible	Visible	Not Consistent	Consistent
5	Medicine Lake Recreation Area: Private Recreation Residence	R & PR	R & PR	Not Visible	Visible	Not Visible	Visible	Not Consistent	Consistent - PR
6	Little Mount Hoffman Lookout	PR & M	R, PR, M	Not Visible	Visible	Not Visible	Visible	Not Consistent	Consistent
7	Primary Forest Route 49: east of proposed power plant site	R	R	Not Visible	Visible	Visible	Not Visible	Not Consistent	Consistent
8	Primary Forest Route 49: Medicine Lake vista point	PR	R	Not Visible	Not Visible	Not Visible	Visible	Not Consistent	Consistent
9	Primary Forest Route 49: crossing point east of Medicine Lake	PR	R	Not Visible	Not Visible	Not Visible	Visible	Not Consistent	Consistent
10	Primary Forest Route 77 (44N50)	R	R	Not Visible	Not Visible	Not Visible	Visible	Not Consistent	Consistent - PR
11	Arnica Sink	PR & M	R & PR	Not Visible	Not Visible	Not Visible	Visible	Not Consistent	Consistent
12	Forest Road 43N99/Lyons Peak Loop Road	PR & M	R & PR	Not Visible	Not Visible	Not Visible	Visible	Not Consistent	Consistent
13	Primary Forest Road 97 (appx. 8 miles west of Hwy. 39 turnoff)	PR & M	M	Not Visible	Not Visible	Not Visible	Visible	Not Consistent	Consistent
14	Tionesta	PR	M	Not Visible	Not Visible	Not Visible	Visible	Consistent	Consistent
15	Timber Mountain Fire Lookout	PR & M	M	Not Visible	Visible	Not Visible	Visible	Not Consistent	Consistent
16	State Highway 139: proposed transmission line route crossing (Segment C1)	PR	R	Not Visible	Not Visible	Not Visible	Visible	Not Consistent	Consistent

Table 4.9-1: Summary of Visual Quality Effects from KOPs, continued

KOP #	Location	VQO [1]	Existing Visual Condition[2]	Wellfield and Power Plant Facilities[3]	Steam Plumes[4]	Lighting[5]	Transmission Line[6]	VQO Achievement Without Mitigation	VQO Achievement After Mitigation
17	State Highway 139: proposed transmission line route crossing (Segment C2)	PR	PR & M	Not Visible	Visible	Not Visible	Not Visible	Consistent	Consistent
18	Lava Beds National Monument: Gillem Camp	P, R, PR & M[6]	P & R	Not Visible	Not Visible	Not Visible	Not Visible	Consistent	Consistent
19	Lava Beds National Road Vista Point	P, R, PR & M[6]	P & R	Not Visible	Not Visible	Not Visible	Not Visible	Consistent	Consistent
20	Lava Beds National Monument: Schonchin Butte Lookout	P, R, PR, & M[6]	P & R	Not Readily Visible	Not Readily Visible	Visible	Not Visible	Consistent	Consistent
21	Lava Beds National Monument: Cave Loop Road	PR & M[6]	P & R	Not Visible	Not Readily Visible	Not Visible	Not Visible	Consistent	Consistent

Notes:

1 Visual Quality Objectives (VQOs) are provided for lands where project features are sited and would be visible from each KOP. VQOs include: P=Preservation; R=Retention; PR=Partial Retention; M=Modification

2 The Existing Visual Condition provides an evaluation about what VQO is currently met (versus planned for) as seen from each KOP. The existing conditions used to make the evaluation include land resource and management activities within the overall seen area whether on public or private lands. Where the KOP is located along a route of travel, the evaluation is based on the view from the road not of the road.

3 Wellfield facilities include wellpads, drill rigs, geothermal fluid pipelines and associated access roads. Power plant facilities include cooling towers, the turbine building, and all related facilities.

4 Steam plumes include both cooling tower steam plumes that would be evident year round during plant operation, and winter well venting steam plumes that would be evident during the construction phase and during the operation phase as a result of periodic in-fill well drilling.

5 Lighting relates to drill rig mast lighting that would be present during the construction phase and as a result of periodic in-fill well drilling during the operation phase. Lighting also relates to power plant facility and perimeter lighting that would be present during the operation phase.

6 VQOs are not available for the Lava Beds National Monument KOPs as the National Park Service does not use VQOs. The VQOs provided for Lava Bed National Monument KOPs are based on the VQOs that occur along the north side of the Medicine Lake Highlands, along the proposed and alternative route alignments that may be seen from this location.

SOURCE: 2M Associates and MHA Environmental Consulting, Inc.

not significant visual impact. The temporary visual effect of vehicles and equipment on forest roads during operation would not result in visual impacts.

Construction: During construction at the wellfield and power plant site, construction employee vehicles and construction vehicles and heavy equipment would be present on forest roads, primarily during the summer months. As described and evaluated in section 4.12, Transportation, this would result in a temporary increase in vehicular traffic in the vicinity of the proposed wellfield and power plant area. As construction employee and vehicle access is proposed to be primarily from the northwest via Primary Forest Route 15, Primary Forest Route 77, Forest Road 44N01, and Forest Road 44N64, as described above, the majority of new trips would occur along these roadways.

The potential presence of construction vehicles and the hauling of equipment and material through either the Lava Beds National Monument or the Medicine Lake Recreation Management Area, could result in a temporary effect on the visual characteristics of these areas as seen from a variety of vantage points. The presence of such vehicles would occur if construction of the proposed transmission line, especially along segments A1 and A2, results in the presence of construction vehicles and heavy equipment along Medicine Lake area roads or if the proposed construction access routes described above, is not adequately enforced.

Additionally, the helicopters that would be used to string conductors may also be seen from a variety of forest roads and recreational destination points such as the Medicine Lake Recreation Management Area and the Lava Beds National Monument, depending upon the specific locations for helicopter staging. Helicopter use would occur during the second summer of construction of the transmission line (i.e., the third year of project construction). Staging is anticipated to occur at either end of the transmission line and at one mid-point location. Therefore, helicopter flights over the Lava Beds National Monument would not occur, but distant views may be available.

Based on the above information, the visibility of construction vehicles and equipment would be a short-term adverse impact.

Operation: During operation, employee vehicle access into the wellfield and power plant area would result in minimal traffic on vicinity roads. Helicopters would not be used during project operation. Therefore, no temporary visual effects are expected from vehicles and equipment during operation.

Decommissioning: Decommissioning of the wellfield, power plant, and transmission line would result in similar short-term adverse visual effects from construction vehicles and equipment as described above for construction.

Mitigation Measures

Implementation of Mitigation Measure 4.12.3a (see Section 4.12, Transportation) would minimize the short-term impact of vehicles and equipment on visual quality.

Level of Significance After Mitigation

Less than significant.

4.9.2 Effects on Wellfield and Power Plant Vicinity Views

Construction and decommissioning of the proposed action would result in short-term adverse visual impacts from Forest Roads 44N54 and 44N64, due to the temporary nature of these activities. Operation of the proposed action would result in a significant impact that could be mitigated; this impact would be related to power plant facility lighting that would be seen from these roads.

Construction: As shown in Figure 2.2-2, Forest Roads 44N54 and 44N64 pass through a portion of the wellfield site. These roads are not primary travel routes or identified KOPs. However, they are evaluated herein as they would afford the only direct views into the wellfield and power plant site.

During the day, vegetation clearance, grading and filling activities, pad construction, drilling rigs, and well venting steam plumes (summer and winter) would be visible in the foreground from portions of both 44N54 and 44N64. Construction of the pipeline to well pads P-2 and I-1 would also be visible from these roads. At night, lighting along the drill rig masts, when in use at the wellfield, would also be visible in the foreground along these roads by passing vehicles. The forest cover that would remain between the power plant and the wellfield would block views of all power plant construction activities and facility erection from both 44N54 and 44N64.

Transmission line right-of-way clearance activities, pole erection, wire stringing, and associated equipment would not be visible from either of these locations, due to intervening topography and forest vegetation.

The visibility of wellfield construction activities from Forest Road 44N54 and 44N64 would be considered a short-term adverse visual impact. This impact would not be significant as the visibility of construction activities would not result in long-term inconsistencies with VQOs. Construction activities would be temporary and the duration of views from these roads would not be more than fifteen to thirty seconds as they would be seen primarily by passing motorists. Therefore, such views would not impact the overall visual characteristics of the vicinity.

Operation: As for the construction phase, on-the-ground operational activities at the wellfield site would also be visible from Forest Roads 44N54 and 44N64. Well pads, well pad maintenance activities, in-fill well drilling (and associated night lighting), and well venting, would be visible. The overall visual effects of these features are similar to those described above for the construction phase, except that the presence of drill rig lighting and well venting steam plumes would occur less frequently (approximately 1 infill well would be drilled every 1 to 2 years).

On-the-ground operational activities at the power plant would not be visible from these roads during the day due to intervening forest cover. However, cooling tower steam plumes from power plant operation would be visible periodically from these roads, in both the winter and the summer. As discussed in the "Methodology" subsection above, the visibility of plumes would be ephemeral due to dispersion and would vary according to climatic conditions. At night, perimeter and facility lighting at the power plant would also be visible from these forest roads.

Similar to the construction phase, the operation and maintenance of right-of-way clearance and transmission line facilities would not be visible from either Forest Road 44N54 or 44N64, due to intervening topography and forest vegetation.

The visibility of wellfield operations, steam plumes, and night lighting from both Forest Road 44N54 and 44N64 would be considered an adverse visual impact. This impact would not be significant as the visibility of wellfield operations would be consistent with the VQO of Modification which covers the wellfield. Likewise, the visibility of cooling tower steam plumes would not result in long-term inconsistency with the VQO of Retention which covers the power plant site, due to the periodic visibility and ephemeral nature of such plumes.

The visibility of drill rig mast lighting in conjunction with power plant facility and perimeter lighting, from these roads, would be considered a significant visual impact. This impact would be significant as this lighting would create a permanent new source of night lighting in the area, which would create a long-term inconsistency with the VQO of Retention which covers the power plant site. While the duration of views of this lighting would be short, lighting would likely draw visual attention as it would create a strong visual contrast with night-time conditions in the immediate surrounding area.

Decommissioning: The visual effects of decommissioning activities at the wellfield and power plant area would be similar to those described above for the construction phase, except the presence of well venting steam plumes and drill rig lighting would be eliminated during this phase of the project. However, the ultimate removal of facilities and revegetation of disturbed areas, associated with decommissioning, would ultimately restore the wellfield and power plant site to pre-project conditions. However long term (50 to 70 years), readily evident contrast would remain between the mature forest canopy that exists in the project area and areas cleared for the project, as it would take many years for the forest to return to pre-project conditions.

As for both construction and operation, decommissioning of the proposed transmission line would not be visible from either of these forest roads due to intervening topography and forest cover.

Mitigation Measures

4.9.2a Well venting shall be conducted to minimize the size and visibility of steam plumes and will include directing geothermal fluids from the wellhead to a portable silencer, allowing for minimization of particulate matter. (C, O)

4.9.2b Although not required to reduce a significant impact, cooling towers shall be designed to minimize the size of the steam plume. Calpine shall review plume reduction technology during design to determine if feasible technology exists. The available technology shall be reviewed with the BLM and USFS. If feasible technology is available, it shall be used in cooling tower construction. (O)

4.9.2c Prepare and submit to the Klamath National Forest Service for approval, a detailed Exterior Lighting Design and Management Plan that incorporates the following guidelines:

- Use lights that may be within view of Primary Forest Route 49 and other identified sensitive viewpoints only when necessary, such as for emergency purposes or when conducting routine night-time maintenance activities.

- Constant area lighting would be limited only to those places that must be observed from a distance for safety purposes.
- Area lighting, cooling tower exterior lighting, and security lighting should be controlled by the use of timed switches and/or motion detector activation control so lights are only on when necessary.
- All light fixtures should include shrouds (either fixed or adjustable), other shielding, or be directed in such a way as to block direct light from Forest Road 49, from identified sites located in the west portion of the Medicine Lake Highlands that are significant to traditional cultural values, and from other identified sensitive viewpoints.
- Drill rig mast lighting shall also be shrouded and directed down the drill mast, not out from it. (This mitigation does not apply to any lighting of masts to meet Federal Aviation Administration requirements.)
- Stray light should be controlled through use of low-brightness fixtures with optical controls. (C, O)

4.9.2d Standard site planning and construction methods would be followed to minimize the visual disturbance to the existing landscape caused by construction. These include methods such as:

- Limiting construction access to identified routes
- Designating layout space and other construction zones to pre-defined areas
- Identifying and clearly delineating grading and construction limit lines around the power plant site, all well pads, and along the pipeline routes
- Clearing of trees should be limited to the minimum area required
- Clearing of land for facilities and structures should use curvilinear boundaries where practical instead of straight lines
- Providing dust control measures
- Removing construction equipment from the project area when no longer needed
- Restoring and revegetating temporary construction areas and equipment storage areas that are no longer needed, in accordance with U.S. Forest Service requirements (C)

4.9.2e Landscape Design: Landscaping should be used in areas visible from Primary Forest Route 49 (the entrance road to the plant site) and Forest Road 44N54 to screen the appearance of project facilities and attain a natural landscape character within a 3-year period to include:

- Shaping cuts and fills to appear as natural forms, to the extent possible
- Stockpiling and reusing topsoil
- Furrowing slopes
- Hydroseeding and mulching clear-cut and fill areas
- Revegetating cut/fill slopes with native shrub and tree species of sufficient size, growth rate, and density
- Fertilizing, mulching, and watering planted areas
- Cutting rock areas so that forms are irregular (C, O)

4.9.2f Facility Design: Appropriate facility design standards and facility materials should be used to reduce the visual contrast between project facilities and the characteristic landscape including, but not be limited to:

- Using paint or integrated material coloring that is uniform, non-contrasting and non-reflective, except where safety colors are required by code
- Selecting facility colors, including any exposed concrete, to blend with the immediate natural environment and to be a shade darker than the adjacent forest landscape to compensate for effects of shade and shadow
- Inspecting and repairing facilities annually to evaluate the buildup of dust or other materials and the effects of weathering processes that will reduce the effect of the original colors
- Using wooden posts for required signs
- Designing a coordinated signing program which minimizes use of signs and is based on approved USFS sign colors
- Using only non-reflective fencing throughout the project (C, O)

Level of Significance After Mitigation

Less than significant. Mitigation Measure 4.9.2c would reduce the significant impact associated with operational night lighting to a less-than-significant level. Mitigation Measures 4.9.2a through 4.9.2f would minimize the overall visual contrast of proposed facilities and the basic landscape elements of line, form, color, and texture, as seen from Forest Roads 44N54 and 44N64.

4.9.3 Effect on Primary Forest Route 49 Views Near the Plant Site

Construction and decommissioning of the proposed action would result in short-term adverse visual impacts from Primary Forest Route 49 (KOP 7) near the plant site and wellfield, due to the temporary nature of these activities. Operation of the proposed action would result in a significant impact that can be mitigated, related to power plant facility lighting that would be seen from this road.

Construction: During the day, on-the-ground construction at the wellfield would not be visible from Primary Forest Route 49 (KOP 7), which is 850 feet east of the site, due to intervening forest cover. Well venting steam plumes could be visible from Route 49 in winter months when plume height is expected to be up to 285 feet. At night, drill rig mast lighting, when in use at the wellfield, would also be visible along Route 49. The density of the forest canopy and average tree height (45 feet) would not be sufficient to block drill rig lighting along the full length of the masts.

The density and forest canopy would block views of all power plant facility construction from Route 49 (KOP 7), including construction and erection of the 92-foot high turbine building. While this structure would project above the forest canopy, it would not be visible due to the line-of-sight angle over the tree line that exists from Route 49. Associated paving improvements made to Route 49 and entrance road improvements would also be noticeable from Route 49, during construction.

Transmission line right-of-way clearance activities and facility development along the proposed transmission line would not be visible from Route 49 (KOP 7), due to intervening topography and forest vegetation.

The visibility of drill rig mast lighting and winter well venting steam plumes from Route 49 would be considered a short-term adverse visual impact. This impact would not be significant as these construction activities would not result in long-term inconsistencies with VQOs. Construction activities would be temporary and the duration of views from this road would not be more than fifteen to thirty seconds as they would be seen by passing motorists.

Operation: As for the construction phase, on-the-ground operational activities at the wellfield site would not be visible from Route 49 during the day due to intervening forest cover. During periodic in-fill well testing, well venting steam plumes could be visible from Route 49 in winter months. The overall visual effect of these plumes is similar to that described above for the construction phase, except that the presence of such plumes would occur less frequently (approximately 1 well would be drilled every 1 to 2 years). Lighting along the drill rig masts, when in use during in-fill well drilling, would also be visible along Route 49 at KOP 7, similar to the construction phase.

On-the-ground operational activities at the power plant would not be readily visible from Route 49 (KOP 7) during the day. Cooling tower steam plumes from power plant operation would be visible periodically from Route 49, in both the winter and the summer. At night, perimeter and facility lighting at the power plant would be visible from Route 49 (KOP 7).

As for the construction phase, the operation and maintenance of the right-of-way clearance and transmission line facilities would not be visible from Primary Forest Route 49 (KOP 7), due to intervening topography and forest vegetation.

As described above for Forest Roads 44N54 and 44N64, the visibility of steam plumes from Route 49 (KOP 7) would be considered an adverse, but not significant visual impact. The operational night lighting would be considered a significant visual impact not consistent with a VQO of Retention.

Decommissioning: No adverse visual impacts would result from decommissioning activities at the wellfield and power plant as such activities would not be visible from KOP 7. As for both construction and operation, decommissioning of the proposed transmission line would not be visible from Route 49 (KOP 7), due to intervening topography and forest cover. Decommissioning activities at the wellfield and power plant facility would not be visible from Route 49 (KOP 7) due to intervening forest cover. Well venting and cooling tower steam plumes and facility lighting would be eliminated during this phase of the project.

Mitigation Measures

Implementation of Mitigation Measures 4.9.2a through 4.9.2f would reduce the visibility of project features from Primary Forest Route 49 (KOP 7).

Level of Significance After Mitigation

Less than significant. Mitigation Measure 4.9.2c would reduce the significant impact associated with operational night lighting, to a less-than-significant level consistent with a VQO of Retention. Mitigation Measures 4.9.2a through 4.9.2f would minimize

the overall visual contrast of proposed facilities and the basic landscape elements of line, form, color, and texture, as seen from Primary Forest Route 49 (KOP 7).

4.9.4 Effects on Views from Medicine Lake Area Roads

Construction and decommissioning of the proposed action would result in short-term adverse visual impacts from Medicine Lake area roads (in particular KOPs 8-10) due to the temporary nature of these activities. Operation of the proposed action related to transmission line facility and right-of-way visibility from KOPs 9 and 10 would result in significant impacts that could be mitigated. Transmission line facility and right-of-way visibility from KOP 8 during operation would result in a significant unavoidable impact.

Construction: Construction activities at the wellfield and power plant area would not be visible from Medicine Lake area roads, including Primary Forest Routes 49 (KOPs 8 and 9) and 77 (KOP 10), and Forest Road 43N48. This is due to the fact that the wellfield and power plant site is physically separated from the Medicine lake area by forest and by major topographic features, including the Medicine Lake Caldera.

Construction activities and facility development along segment A1 of the proposed transmission line route would be visible from Primary Forest Routes 49 and 77 (KOPs 8-10), but not Forest Road 43N48, due to intervening forest cover. Construction of other segments of the proposed line would not be visible from any of these vantage points. Some of the construction activities that would occur over the two-year construction period (summer months only) and that would be visible from these roads are listed below.

- Removal of existing vegetation along the proposed transmission line as part of right-of-way clearance
- Vegetation clearing, earth moving, hauling cement, dust control, and other work associated with transmission line right-of-way clearance and facility construction done by large construction equipment
- Cut and fill grading necessary to develop access roads along the transmission line, transmission line access roads, transmission line tower footings, and associated layout and staging areas
- Construction of access roads and transmission line facilities, including pole erection and wire stringing

Right-of-way clearing, grading, access road construction, and transmission line construction would be seen in the foreground where the transmission line would cross Primary Forest Routes 49 and 77 (KOPs 9 and 10, respectively). As described in the "Methodology" section above, an approximate 100-foot area under the conductors of segment A1 would be largely cleared of trees. Trees on either side of this cleared area (approximately 12.5 feet on either side) would be trimmed and scalloped, as illustrated in Figure 2.2-10. This vegetation clearance would produce a pronounced transmission line path, which would be visible in the foreground from road crossings as would poles and other facility elements being erected. These elements would be visually dominant in terms of their line, texture, form, and color when seen by passing vehicles. Transmission line construction activities for segment A1 at these road crossings could affect views from approximately 1/4 mile in either direction of crossings.

Transmission line construction for segment A1 would be seen in the middleground when looking south from the Medicine Lake overlook on Primary Route 49 (KOP 8). During pole erection and wire stringing, the upper portions of transmission line poles and conductors would be visible in the middleground (between mileposts 1.0 and 2.2) from this south-facing view towards Medicine Lake during tower erection and wire stringing. This view would be from an elevated position looking down on the transmission line with the forest, Medicine Lake, and Medicine Mountain in the background. Figure 4.9-1 provides a visual simulation of project features that would be visible from this KOP.

The visibility of the transmission line right-of-way clearance activities and erection of structures for segment A1 from Medicine Lake Area roads (KOPs 8-10) would be considered a short-term adverse visual impact. This impact would not be significant as construction activities would not result in long-term inconsistencies with VQOs. Additionally, the duration of views by passing motorists would be short, lasting approximately fifteen to thirty seconds, thereby not impacting the overall visual character of the Medicine Lake vicinity.

Operation: As for construction, operation activities at the wellfield and power plant area would not be visible from Medicine Lake area roads including Primary Forest Routes 49 (KOPs 8 and 9) and 77 (KOP 10), and Forest Road 43N48.

The visibility of segment A1 of the proposed transmission line from Medicine Lake area roads (KOPs 8-10) would be similar to that described above for construction, except that structures would be fully erected and would be maintained throughout the life of the project. Operation of the transmission line involving maintenance activities such as tree trimming and maintenance vehicle activity within the right-of-way or along access roads may be visible at the road crossings (KOPs 9 and 10). However, these temporary activities (expected to occur twice a year in the spring and fall) would not impact the overall visual characteristics or views in the area.

The visibility of segment A1 of the transmission line from KOPs 9 and 10 would be considered a significant visual impact that could be mitigated. The impact is significant prior to mitigation as the presence of the transmission line over the life of the proposed action would result in a long-term inconsistency with the VQOs of Retention and Partial Retention that exist at these road crossings. The proposed action would result in the crossing of Primary Forest Routes 49 (KOP 9) and 77 (KOP 10), both of which are inventoried sensitive routes of travel. While the duration of views by passing motorists at these road crossings would be only for a brief period, a visitor entering and traveling through the Medicine Lake area would likely see the transmission line at several forest road locations, including KOPs 8-10. Therefore, the long-term visual contrast created by the presence of the right-of-way and poles along segment A1 would be significant. Mitigation measures proposed below would eliminate the long-term inconsistencies with VQOs and would reduce the impact to a less-than-significant level. The use of non-specular conductors, which is planned, would reduce the reflection and glare from the transmission line.

Figure 4.9-1: Existing View and Visual Simulation of Proposed Action from KOP #8



Simulation of proposed transmission line route (Segment A1) as seen from Primary Forest Route 49 looking south towards Medicine Lake. Medicine Lake Lava Flow is located on the left edge of the photo.



Existing view from Primary Forest Route 49 looking south towards Medicine Lake.

Note: The simulation above is a copy of a photographic file. Therefore, the degree of clarity and contrast presented is somewhat reduced as compared with the original image.

SOURCE: 2M Associates

The presence of the transmission line over the life of the proposed action would not result in a long-term inconsistency with the VQO of Partial Retention that exists along the portion of the transmission line that would be seen from this KOP. While the transmission line would be visible, it would not dominate the landscape as seen from this vantage point. The visibility of segment A1 of the transmission line from KOP 8 would, however, be considered a significant unavoidable visual impact as no mitigation is available that would remove this facility from view. Additionally, the duration of views is longer on average than would occur at the road crossings, as KOP 8 is used as an overlook point, which provides panoramic views of the Medicine Lake Lava Flow, Medicine Lake, and Medicine Mountain to the south. The use of non-specular conductors, as planned, would reduce the reflection and glare from the transmission line.

Decommissioning: As for construction, short-term adverse visual impacts would occur at these KOPs during decommissioning of the transmission line. The ultimate removal of facilities and revegetation of disturbed areas, associated with decommissioning, would restore the transmission line route to pre-project conditions, which is considered a beneficial effect. However, a long-term, readily evident contrast would remain between the mature forest canopy that exists in the project area and areas cleared for the project, as it would take many years for the forest to return to pre-project conditions.

Mitigation Measures

4.9.4a For the entire transmission line route, implement the following measures to minimize the visual effects of right-of-way vegetation clearance and transmission line facilities:

- To minimize the need for excessive vegetation clearing from the transmission line right-of-way, prepare a detailed transmission line clearing plan for review and approval by the USFS that takes into account basic principles of feathering and scalloping of the transmission line right-of-way
- Prior to clearing activities, identify those trees to be removed, trees to be pruned, and trees to remain within the transmission line right-of-way, with review and approval by the USFS
- To reduce reflection and glare, use only non-specular conductors as is already planned for by Calpine
- To reduce reflection and glare of metal poles, use flat paint or integrated material coloring except where safety colors are required by code. (C)

4.9.4b The following measures shall be implemented at road crossings and at the segment A1 crossing of the Medicine Lake Lava Flow Trail in order to minimize the establishment of a visual corridor from vegetation clearing under the conductor, minimize views down the transmission line right-of-way, and reduce the dominance of the transmission line:

- For each transmission pole immediately adjacent to the road, use self-supporting single steel poles rather than H-frame poles.
- Site transmission line poles as far away as practical from either side of the road; redirect the transmission line right-of-way from the two poles adjacent to the road at a sufficient angle so that only that portion of the right-of-way between the two poles nearest the road may be visible from the road.

- Retain all trees within the right-of-way between 5 feet and 12 feet in height depending upon the height of the conductors in that segment (30 or 37 feet clearance between the conductor and the ground)
- Regrade to create designed earth berms and/or plant native trees and understory vegetation within 100 feet on either side of the roadway at a density, size, and growth rate sufficient to screen views into the right-of-way from the roadway within a 3-year period. (C,O)

4.9.4c Reroute the transmission line and utility corridor along segment A1 slightly west of the proposed alignment to avoid crossing Primary Forest Route 77 in a VQO Retention area. This shall be accomplished by rerouting segment A1 at approximately 0.25 mile from the power plant, due south for approximately 0.75 mile. At approximately 1.0 mile from the power plant, the line shall be redirected back towards the southeast for approximately 1.25 miles to just north of Medicine Lake. From this point just north of Medicine Lake the segment shall continue to follow the proposed alignment of segment A1. Rerouting the transmission line and utility corridor in accordance with this measure shall result in the crossing of Primary Forest Route 77 in a VQO of Partial Retention. (C)

Level of Significance After Mitigation

Mitigation Measures 4.9.4a and 4.9.4b would be sufficient to reduce the level of impact at the Primary Forest Route 49 crossing (KOP 9), to a less-than-significant level. Mitigation Measures 4.9.4a, 4.9.4b, and 4.9.4c would be required to reduce the level of impact of the Primary Forest Route 77 crossing (KOP 10), to a less-than-significant level. The visual impacts from the Medicine Lake overlook (KOP 8) would remain significant and unavoidable, as the transmission line facilities for segment A1 would remain visually evident from this vantage point over Medicine Lake.

4.9.5 Effects on Medicine Lake Views

Construction and decommissioning of the proposed action would result in short-term adverse visual impacts from Medicine Lake Views (which include KOPs 1-5), due to the temporary nature of these activities. Operation of the proposed action related to transmission line facility and right-of-way visibility from KOP 4, would result in a significant impact that can be mitigated. Transmission line facility and right-of-way visibility, and steam plume visibility from KOP 2, 3, and 5 would result in a significant unavoidable impact.

Construction: During the day, ground-level construction activities and facility development at the wellfield and power plant area would not be visible from the Medicine Lake area (KOPs 1-5). Likewise, night lighting from the drill rigs would not be visible from these KOPs.

Steam plumes emitted during well venting in the winter would be visible at times in the middleground from several of the Medicine Lake area KOPs (KOPs 2, 3, and 5). These plumes could potentially rise above the northeastern rim of the Medicine Lake Caldera, near Grouse Hill, thereby being visible from these vantage points. Well venting steam plumes would not be visible from KOPs 1 and 4, as there are not long-range views towards the northeastern rim of the Caldera from these KOPs.

From the A. H. Hogue Campground (KOP 1) along the north shore of Medicine Lake, transmission line construction would not be visible as views from this location are to the south over Medicine Lake. From the other Medicine Lake area KOPs (2-5),

construction activities and facility development along segment A1 of the proposed transmission line route would be visible. Construction of other segments of the proposed transmission line would not be visible from Medicine Lake views.

Views of transmission line construction and facility erection for segment A1 from the Medicine Lake area (KOPs 2, 3, and 5) would be either in the middleground or background. During pole erection and wire stringing, the upper elements of the transmission line poles and conductors would be visible above the forest canopy from north-facing, middleground views over Medicine Lake towards the Medicine Lake Lava Flow. This view is demonstrated in the visual simulations for KOP 2 and 3 shown in Figures 4.9-2 and 4.9-3. The facilities would occur above the skyline as they cross over the eastern shoulder of Grouse Hill. The right-of-way clearance over the eastern shoulder of

Grouse Hill, would also be visible. The visual simulation of KOP 2 demonstrates these project effects (see Figure 4.9-2). These changes would alter the intactness of the existing landscape character and would be viewed as a permanent feature of the landscape from the existing boat launch area and recreation residences that front the south side of the Lake. Additionally, extended periods of exposure and a potential alteration of the recreation experience of boaters would result.

The transmission line construction and facility erection of segment A1 would be seen by hikers where it crosses the Medicine Lake Lava Flow Trail (KOP 4). The right-of-way clearance and transmission line facilities would cross this trail and be visible in the foreground and middleground for approximately a one to two minute period each way as hikers walk the trail to and from the lava flow. The facilities and right-of-way corridor's scale would be a dominate feature and would create a high level of visual contrast altering the intactness of the existing landscape character.

The visibility of winter well venting steam plumes and segment A1 construction and facility erection as seen from Medicine Lake area KOPs 2-5 would be considered a short-term adverse visual impact. This impact would not be significant as construction activities would not result in long-term inconsistencies with VQOs. Additionally, the visibility of the well venting steam plumes would be ephemeral and would occur during the winter when there are few visitors at these KOPs.

Operation: Wellfield and power plant facilities and associated lighting would not be visible from any of the Medicine Lake KOPs (1-5).

Steam plumes from both well venting and power plant cooling towers would be visible from several of the Medicine Lake area KOPs. The visual effect of well venting steam plumes associated with infill well drilling during operation would be similar to that described above for construction, except that they would occur less frequently. Cooling tower steam plumes could also be visible in the background from Medicine Lake KOPs 2, 3, and 5, during both winter and summer. Figure 4.9-3 illustrates the likely visibility of the cooling tower steam plume during the summer, based on the visual simulation of the proposed action conducted for this KOP.

The visibility of segment A1 of the transmission line from Medicine Lake area KOPs would be similar to that described above for construction, except that structures would

be fully erected and would be maintained throughout the life of the project. Operation of the transmission line involving maintenance activities such as tree trimming and maintenance vehicle activity within the right-of-way or along access roads may be visible from some locations. However, these temporary maintenance activities (expected to occur twice a year in the spring and fall) would not impact the overall visual characteristics or views in the area.

The presence of the transmission line (segment A1) over the life of the project would not create an unavoidable long-term inconsistency with the VQO of Retention that applies in portions of the Medicine Lake area. Mitigation is recommended that would relocate segment A1 so that the visible portions of the transmission line from these KOPs are not located in a VQO Retention area as seen from these KOPs. The visibility of well venting and cooling tower steam plumes and transmission line facilities and right-of-way clearance for segment A1 from KOPs 2, 3, and 5, however, is considered a significant unavoidable impact as no mitigation is available that would remove these project features from view. The visibility of the transmission line poles and conductors above the treeline, and the visibility of the right-of-way clearance and skylining of facilities over Grouse Hill, would create a high level of visual contrast. Duration of these views would be much longer from KOPs 2, 3, and 5 as recreational activities and residential uses occur at these KOPs. The visibility of steam plumes, while not resulting in long-term inconsistencies with VQOs, would contribute to the overall modification of the visual characteristics of the Medicine Lake area as seen from these KOPs.

The visibility of segment A1 of the transmission line in the foreground and middle ground from the Medicine Lake Lava Flow Trail (KOP 4) would also be considered a significant unavoidable impact. The transmission line would not, however, create an unavoidable long-term inconsistency with the VQO of Partial Retention that exists in the vicinity of this trail. The Partial Retention designation allows activities to introduce forms, lines, colors, and textures that are found infrequently or not at all in the characteristic landscape. The facility would not be a dominant element of the landscape after implementation of Mitigation Measures 4.9.4a and 4.9.4b. These measures would minimize the visual effect of the transmission line and associated vegetation clearance at the segment A1 crossing of the Medicine Lake Lava Flow Trail.

Decommissioning: As for construction, short-term adverse visual impacts would occur during decommissioning as a result of dismantling and removing transmission line facilities. The ultimate removal of facilities and revegetation of disturbed areas, associated with decommissioning, would restore the transmission line route to pre-project conditions, which is considered a beneficial effect. However, long-term (50 to 70 years), readily evident contrast would remain between the mature forest canopy that exists in the project area and areas cleared for the project, as it would take many years for the forest to return to pre-project conditions.

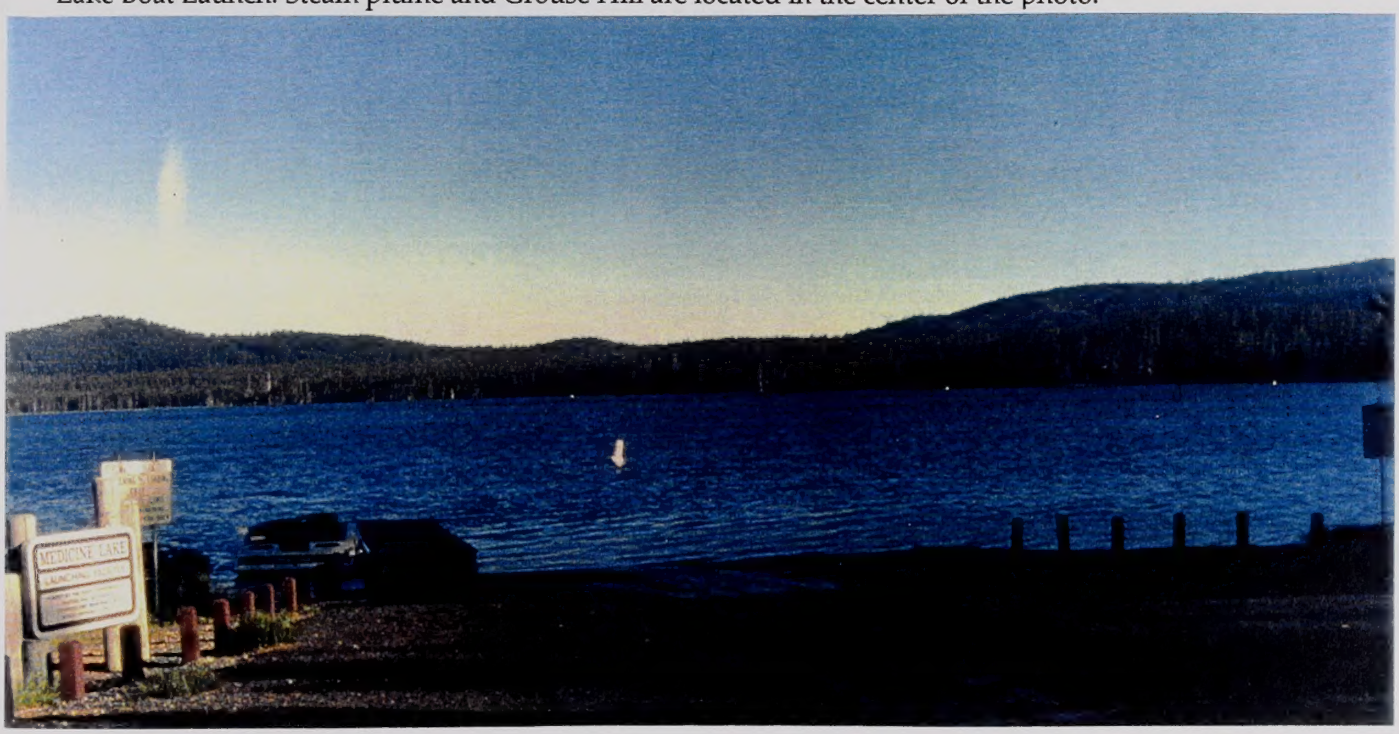
Mitigation Measures

Implementation of Mitigation Measures 4.9.2a, 4.9.2b, 4.9.4a, and 4.9.4b, and the following mitigation measures would reduce the visibility of project features from

Figure 4.9-2: Existing View and Visual Simulation of Proposed Action from KOP #2



Simulation of proposed transmission line route (Segment A1) and steam plume as seen from Medicine Lake Boat Launch. Steam plume and Grouse Hill are located in the center of the photo.



Existing view from Medicine Lake Boat Launch looking northwest.

Note: The simulation above is a copy of a photographic file. Therefore, the degree of clarity and contrast presented is somewhat reduced as compared with the original image.

SOURCE: 2M Associates

Figure 4.9-3: Existing View and Visual Simulation of Proposed Action from KOP #3



Simulation of proposed transmission line route (Segment A1) as seen from the south side of Medicine Lake looking north towards the Medicine Lake Lava Flow.



Existing view from south side of Medicine Lake looking north towards the Medicine Lake Lava Flow.

Note: The simulation above is a copy of a photographic file. Therefore, the degree of clarity and contrast presented is somewhat reduced as compared with the original image.

SOURCE: 2M Associates

Medicine Lake area KOPs:

4.9.5a Shorten distance between transmission line poles on segment A1 (between mileposts 0.6 and 3.3), to allow for shorter poles while still maintaining adequate clearance between the ground and the conductors (37 feet in the Medicine Lake area) to allow for snow pack. This may reduce the visibility of poles as seen from the Medicine Lake KOPs 2, 3, and 5 by taking advantage of the forest canopy to partially screen the facilities. However, the visibility of the conductors would not be modified by this measure. (C, O)

4.9.5b The following measures shall be implemented along segment A1 (between mileposts 2.9 and 3.2) to reduce visual dominance and right-of-way corridor effects as seen from the Medicine Lake Lava Flow Trail (KOP 4):

- Site transmission line towers approximately 200 feet on either side and perpendicular to trail; redirect transmission line right-of-way from the two towers adjacent to the trail at a sufficient angle so that only that portion of the right-of-way between the two towers nearest the trail may be visible from the trail.
- Retain all trees within the right-of-way between 5 feet and 12 feet in height depending upon the height of the conductors in that segment (would range between 30 and 37 feet).
- Where possible, based on the characteristics of the individual tree species involved, top or prune trees taller than 12 feet rather than remove them.
- Annually inspect and remove/top only those trees that are necessary for safety purposes. (C, O)

4.9.5c Within the designated Medicine Lake Recreation Area, construction activities will be limited from sunrise to sunset in order to limit the need for lighting during the construction phase of the project. (C)

Level of Significance After Mitigation

Significant unavoidable. The visual impacts from the Medicine Lake shoreline (KOPs 2, 3, and 5) would be considered significant and unavoidable as it is unlikely the Mitigation Measure 4.9.5a would eliminate the visibility of the segment A1 transmission line and poles from these KOPs. Mitigation Measures 4.9.2a and 4.9.2b would not eliminate the visibility of well venting and cooling tower steam plumes from these KOPs. Therefore, with mitigation the visibility of segment A1 of the transmission line would result in a significant unavoidable impact as the visibility of both the transmission line and steam plumes would impact the overall visual characteristics of the Medicine Lake area.

Impacts to the Medicine Lake Lava Flow Trail would also remain significant with implementation of Mitigation Measure 4.9.4b, as the segment A1 transmission line right-of-way and facilities would highly contrast with the characteristic landscape, and would reduce the existing level of intactness along the trail.

4.9.6 Effect on Little Mount Hoffman Views

Construction and decommissioning of the proposed action would result in short-term adverse visual impacts from Little Mount Hoffman (KOP 6), due to the temporary nature of these activities. Operation of the proposed action related to transmission line facility and right-of-way visibility from KOP 6 would result in a significant impact that could be mitigated.

Construction: On-the-ground construction activities and facility development at the wellfield and power plant area, including drill rig mast lighting, would not be visible from Little Mount Hoffman (KOP 6). This is due to the presence of Grouse Hill and the Crater Glass Flow, which block views from Little Mount Hoffman to this site. However, steam plumes from well venting would be visible at times during winter time conditions when the plume would be high enough to be seen from this vantage point.

The upper portions of poles and conductors (during pole erection and wire stringing) for segment A1 would be visible in the middleground (between mileposts 0.3 to 0.8) from this location and would be viewed from an elevated position looking down against the forest backdrop. Pole erection and wire stringing would be seen above the skyline at the segment A1 crossing of the Caldera rim near Grouse Hill.

The visibility of winter well venting steam plumes and segment A1 construction and facility erection as seen from Little Mount Hoffman (KOP 6) would be considered a short-term adverse visual impact, as described above for other KOPs.

Operation: The visibility of segment A1 of the transmission line from Little Mount Hoffman would be similar to that described above for construction, except that structures would be fully erected and would be maintained throughout the life of the project. Operation of the transmission line involving maintenance activities such as tree trimming and maintenance vehicle activity within the right-of-way or along transmission line access roads may be visible from this KOP. However, these temporary maintenance activities (expected to occur twice a year in the spring and fall) would not impact the overall visual characteristics or views from this vantage point.

The visibility of well venting and cooling tower steam plumes and segment A1 transmission line facilities and right-of-way clearance from KOP 6 is considered a significant impact. This impact is significant as the presence of the transmission line (segment A1) over the life of the project would create a long-term inconsistency with the VQO of Partial Retention that occurs along the visible portion of segment A1, as seen from this KOP.

Decommissioning: As for construction, short-term adverse visual impacts would occur with decommissioning as a result of dismantling and removing transmission line facilities. The ultimate removal of facilities and revegetation of disturbed areas, associated with decommissioning, would restore the transmission line route to pre-project conditions, which is considered a beneficial effect. However, long-term (50 to 70 years), readily evident contrast would remain between the mature forest canopy that exists in the project area and areas cleared for the project, as it would take many years for the forest to return to pre-project conditions.

Mitigation Measures

Implement Mitigation Measure 4.9.2a, 4.9.2b, and 4.9.4a to reduce the visibility of project features from Little Mount Hoffman.

Level of Significance After Mitigation

Less than significant. The visual impacts from Little Mount Hoffman (KOP 6) would be considered less than significant as Mitigation Measure 4.9.4a would reduce the visibility

of the segment A1 transmission line poles and conductors from this KOP. While the transmission line facilities would remain somewhat visible from this KOP, they would be consistent with the VQOs of Partial Retention and Modification.

4.9.7 Effect on Arnica Sink and Glass Mountain Views

Construction and decommissioning of the proposed action would result in short-term adverse visual impacts from Arnica Sink (KOP 11) and Lyons Peak Loop Road near Glass Mountain (KOP 12). Operation of the proposed action related to transmission line facility and right-of-way visibility from KOPs 11 and 12 would result in a significant impact that could be mitigated.

Construction: Construction activities and facility development associated with the wellfield and power plant area, including drill rig mast lighting and well venting steam plumes, would not be visible from either Arnica Sink or the Lyons Peak Loop Road (KOPs 11 and 12), due to intervening topography and forest cover.

Transmission line right-of-way clearance and facility construction along a half-mile portion of segment A1 (between mileposts 3.5 and 4.1) would be visible from Arnica Sink (KOP 11). The upper portions of poles and conductors (during pole erection and wire stringing) would be visible in the middleground from this KOP and would be viewed against a forest backdrop. The upper portions of poles and conductors (during pole erection and wire stringing) would also be visible in the middleground from the Lyons Peak Loop Road (KOP 12), along a mile portion of segment A2. The view from this KOP would be from an elevated position looking down on the transmission line, against a forest backdrop.

While not visible from KOP 12 or any other KOP, the transmission line along segment A2 (between mileposts 7.0 and 8.0) would cross Glass Mountain in the vicinity of the Glass Mountain Lava Flow, which has a VQO of Preservation. The transmission line along segment A2 would pass a gap between the main portion of the lava flow on the east and a small remnant portion of the lava flow on the west. This gap between the two portions of the lava flow has a VQO of Modification. Section A2 therefore would not actually cross the lava flow and the area that has a VQO of Preservation. Although, it should be noted that Figure 4.9-2 and the generalized VQO mapping provided in the Klamath National Forest LRMP are not at scales that are sufficient to show the gap between these portions of the lava flow and the associated VQO designations.

The transmission line construction and facility erection as seen from Arnica Sink (KOP 11) and the Lyons Peak Loop Road (KOP 12) would be considered a short-term adverse visual impact, as described above for other KOPs.

Operation: Similar to construction, operation of the wellfield and power plant, including all facility lighting and steam plumes, would not be visible from either Arnica Sink or the Lyons Peak Loop Road (KOPs 11 and 12), due to intervening topography and forest cover.

During operation, the visibility of the transmission line from Arnica Sink and the Lyons Peak Loop Road would be similar to that described above for construction, except that structures would be fully erected and would be maintained throughout the life of the project. Operation of the transmission line involving maintenance activities such as tree

trimming and maintenance vehicle activity within the right-of-way or along access roads may be visible from these KOPs. However, these temporary activities (expected to occur twice a year in the spring and fall) would not impact the overall visual characteristics or views from this vantage point.

The visibility of transmission line facilities and right-of-way clearance for segment A1 and A2 from Arnica Sink (KOP 11) and the Lyons Peak Loop Road (KOP 12), respectively, would be a significant impact that can be mitigated. This impact is significant as the presence of the transmission line (segments A1 and A2) over the life of the project would create a long-term inconsistency with the VQO of Partial Retention that occurs along these segments in areas visible from KOP 11 and 12. The presence of the transmission line (segments A1 and A2) over the life of the project would not create a long-term inconsistency with the VQO of Modification that also occurs along these segments in areas visible from KOP 11 and 12.

Decommissioning: Similar to construction, short-term adverse visual impacts would occur with decommissioning as a result of dismantling and removing transmission line facilities. The ultimate removal of facilities and revegetation of disturbed areas, associated with decommissioning, would restore the transmission line route to pre-project conditions, which is considered a beneficial effect. However, long-term (50 to 70 years), readily evident contrast would remain between the mature forest canopy that exists in the project area and areas cleared for the project, as it would take many years for the forest to return to pre-project conditions.

Mitigation Measures

Implement Mitigation Measure 4.9.4a to reduce the visibility of the proposed transmission line from Arnica Sink and the Lyons Peak Loop Road.

Level of Significance After Mitigation

Less than significant. The visual impacts from Arnica Sink and the Lyons Peak Loop Road (KOPs 11 and 12) would be reduced to a less-than-significant level with Mitigation Measure 4.9.4a. While the facilities would remain visible from these KOPs, they would not affect the level of intactness that exists in the forest consistent with the VQOs of Partial Retention and Modification assigned to these areas.

4.9.8 Effects on Tionesta and Vicinity Views

Construction and decommissioning of the proposed action would result in short-term adverse visual impacts from the Tionesta area (KOPs 13-16). Operation of the proposed action related to transmission line facility and right-of-way visibility from these KOPs would result in significant impacts that can be mitigated. Because of the existing forest cover and relatively short duration of foreground exposure to the transmission line crossing to motorists of approximately fifteen to thirty seconds, the transmission line would not reduce the level of intactness from KOP 17 and no significant or adverse impacts during construction, operation, and decommissioning would occur.

Construction: Most construction activities and facility development at the wellfield and power plant area, including drill rig mast lighting, would not be visible from the Tionesta area (KOPs 13 through 17). This is due to the approximate 23 mile distance from the site and as the Medicine Lake Highlands would block such views. It is

possible, however, that winter well venting steam plumes could be visible at times from Timber Mountain (KOP 15) and State Highway 139 (KOP 17). Both of these locations are at a sufficiently high elevation and at such an angle that Glass Mountain and Mt. Hoffman would not block such views. However, it is unlikely that viewers at these KOPs would be able to discern a defined steam plume in the panoramic views to the west that are available from these KOPs. The size of the plume as seen from these vantage points would be so small that it would not be noticeable by most viewers. Additionally, the visibility of these plumes would be ephemeral and would vary according to temperature and wind conditions.

Construction activities along the proposed transmission line route east of the Medicine Lake Highlands (along segments B1 and C1) would be visible from Tionesta KOPs, as described below. Transmission line facility construction (pole erection and wire stringing) would be seen in the foreground from Tionesta (KOP 14) and State Highway 139 (KOP 16), and would be viewed through sparse pines with the land and sky as a backdrop. Middleground and background views of the proposed transmission line are limited from these KOPs (14 and 16) due to forest cover.

A portion of the transmission line right-of-way clearance (primarily associated with segment B1) would be visible from KOPs 13 and 15 in the middleground and background coming down from the Medicine Lake Highlands area. The clearance coming down the highlands would create a swath effect that would be visible from a distance due to the contrast that would occur with the homogeneous forest cover on either side. This contrast would be stronger in the winter months when snow would cover the cleared area. The color contrast between the snow and the adjacent forest cover on either side would accentuate the visibility of the right-of-way clearance from these locations. Right-of-way vegetation clearance with the level portion of segment C1 would be minimal due to the nature of existing vegetation. Therefore, a visible right-of-way clearance would not be apparent in foreground views from these KOPs (13 and 15). Figure 4.9-4 illustrates the likely visibility of the proposed transmission line as seen from KOP 13, based on the visual simulation conducted for this KOP.

The transmission line construction and facility erection as seen from the Tionesta area (KOPs 13-16) would be considered a short-term adverse visual impact as described above for other KOPs.

Operation: During operation, the wellfield and power plant area and associated facilities would not be visible from the Tionesta area (KOPs 13-17), and vicinity. Perimeter and facility lighting from the power plant area would also not be visible from the Tionesta area

nor would any indirect night glow effects be visible. The cooling tower steam plumes and winter well venting steam plumes (during infill well drilling and testing) would be visible in the background from the Timber Mountain Fire Lookout (KOP 15) and State Highway 139 (KOP 17) and other local roads where the uplift of the Medicine Lake Highlands is seen in its entirety. The visibility of these plumes from Tionesta KOPs would be similar to that described above for construction.

During operation, the visibility of segment B1 and C1 of the transmission line from Tionesta KOPs would be similar to that described above for construction, except that

structures would be fully erected and would be maintained throughout the life of the project. Operation of the transmission line involving maintenance activities such as tree trimming and maintenance vehicle activity within the right-of-way or along access roads may be visible from these KOPs. However, these temporary activities (expected to occur twice a year in the spring and fall) would not impact the overall visual characteristics or views from this vantage point.

The visibility of the transmission line facility and right-of-way clearance for segments B1 and C1 from the Tionesta area (KOPs 13-16) would be considered a significant impact that could be mitigated. This impact would be significant as the presence of the transmission line (segments B1 and C1) over the life of the project would create a long-term inconsistency with the portions of these segments that have a VQO of Partial Retention.

The proposed action would result in the crossing of Forest Road 44N01, Primary Forest Route 10, and State Highway 139 in the Tionesta area, all of which are inventoried sensitive routes of travel. While this is the case, because of the moderate forest cover of ponderosa pine and junipers, the presence of the proposed line would not substantially alter the intactness of the landscape character as perceived from Tionesta or in the greater Modoc Plateau. The use of non-specular conductors as planned, would also reduce the reflection and glare from the transmission line as seen from these KOPs.

Decommissioning: Similar to construction, short-term adverse visual impacts would occur with decommissioning as a result of dismantling and removing transmission line facilities. The ultimate removal of facilities and revegetation of disturbed areas, associated with decommissioning, would restore the transmission line route to pre-project conditions, which is considered a beneficial effect.

Mitigation Measures

Implement Mitigation Measure 4.9.2a, 4.9.2b, and 4.9.4a to reduce the visibility of project features from Tionesta area.

Level of Significance After Mitigation

Less than significant. Mitigation Measure 4.9.4a would reduce the visibility of the transmission line. Project features would be consistent with VQOs of Partial Retention and Modification.

4.9.9 Effects on Lava Beds National Monument Views

Construction of the proposed action would result in short-term significant visual impacts from Schonchin Butte (KOP 20) within the Lava Beds National Monument, related to drill rig lighting, that can be mitigated. Operation of the proposed action related to power plant and drill rig lighting as seen from Schonchin Butte would result in significant impacts that can be mitigated. No other Lava Beds National Monument KOPs would be affected. Decommissioning of the proposed action would not result in significant or adverse impacts from Lava Beds National Monument KOPs.

Construction: Construction of proposed facilities in the wellfield and power plant area would not be visible from the Lava Beds National Monument KOPs (18, 19, 20, and 21). The upper portions of the drill rig masts on drill pads I-1 and I-3 would be visible from

Figure 4.9-4: Existing View and Visual Simulation of Proposed Action from KOP #13



Simulation of proposed transmission line route (Segment B1) as seen from Primary Forest Route 97 looking east towards the Glass Mountain Lava Flow. Glass Mountain is located on the far left edge of the photo.



Existing view from Primary Forest Route 97 looking east towards the Glass Mountain Lava Flow.

Note: The simulation above is a copy of a photographic file. Therefore, the degree of clarity and contrast presented is somewhat reduced as compared with the original image.

SOURCE: 2M Associates

Schonchin Butte (KOP 20) within the Lava Beds National Monument. The drill rig masts, however, would blend into background views from this KOP due to the southern orientation into the sun and the distance from the wellfield (approximately 8 miles). The rigs would occupy only a small percentage of the overall expansive panorama and would be visually subordinate in the overall landscape. Drill rig mast lighting would also be visible in the background from Schonchin Butte (KOP 20) but not from any of the other Lava Beds National Monument KOPs due to intervening topography.

Steam plumes related to well venting may be periodically visible from Schonchin Butte during the winter, when plume size is greatest. As described above for the Tionesta area, the size of the plume as seen from this vantage point would be so small that it would not be noticeable by most viewers. Additionally, the visibility of these plumes would be ephemeral and would vary according to temperature and wind conditions.

Transmission line construction activities and facility development would not be visible from Lava Beds National Monument KOPs. Segment A1 would not be visible as it would occur on the southern side of the Medicine Lake Highlands and would be blocked from view. Segments A2 and B1 coming out of the Highlands on the north side would not be visible with the naked eye from Schonchin Butte, due to the distance from this vantage point, as illustrated in Figure 4.9-5. The visual simulation of segments A2 and B1 from Schonchin Butte, illustrates that facility construction and pole erection would not be visible due to the distance to the route. Figure 4.9-6 provides an artist's rendering of these segments, to illustrate how they would fall in the landscape. The transmission line route defined in the rendering by a white line is not to scale and it not intended to depict how these facilities would actually look from Schonchin Butte.

The visibility of drill rig night lighting during construction would result in a short-term significant impact as seen from Schonchin Butte (KOP 20). It is possible that night lighting could be visible from other volcanic buttes or cinder cores within the Monuments two wilderness areas. As visitors to the wilderness areas could potentially perceive this night lighting, a significant impact could occur, in accordance with the NPS visual resource policies. As transmission line construction would not be visible from Lava Beds National Monument, no visual effects from facility construction would occur.

Operation: During operation, the visibility of drill rig masts during day time and night time conditions from Schonchin Butte (KOP 20) would be similar to that described above for project construction. Although, as infill well drilling would occur less frequently, the rigs would be visible only on a periodic basis. Perimeter and facility lighting from the power plant area may be visible from Schonchin Butte (KOP 20). As no area lighting now exists in the Medicine Lake Highlands, perimeter and facility lighting from the power plant area may create an indirect glow that would contrast with the night sky as seen from this and potentially other Lava Beds National Monument vantage points. This effect would be most noticeable under conditions when the moon is not full or the sky is overcast. This effect would be particularly evident during winter snow conditions when reflected light would add to the contrast.

Schonchin Butte and other Lava Beds National Monument locations where the uplift of the Medicine Lake Highlands can be seen in its entirety. The likely visibility and detection of these plumes from Schonchin Butte would be similar to that described above for construction.

During operation, the visibility of the transmission line from Schonchin Butte would be similar to that described above for construction, except that structures would be fully erected and would be maintained throughout the life of the project. Operation of the transmission line involving maintenance activities such as tree trimming and maintenance vehicle activity within the right-of-way or along access roads would not be visible from this KOP.

The visibility of power plant facility lighting from KOP 20 would be considered a significant impact that could be mitigated. This impact would be significant as the presence of night lighting over the life of the project would create a long-term inconsistency with VQOs. Additionally, the visible presence of night lighting could potentially create a strong visual draw and would contrast with the adjacent nighttime conditions. Without mitigation, nighttime views from Lava Beds National Monument wilderness areas could be adversely affected, as described above for construction.

Decommissioning: Decommissioning activities associated with dismantling and removing facilities at the wellfield and power plant area and along the transmission line would not be visible from Lava Beds National Monument. Therefore, significant or adverse impacts would not occur in the Monument's two wilderness areas.

Mitigation Measures

Implement Mitigation Measures 4.9.2a, 4.9.2b, and 4.9.2c above to reduce the visibility of project features from Schonchin Butte (KOP 20) and other Lava Beds vantage points, including the two wilderness areas.

Level of Significance After Mitigation

Less than significant. Implementation of Mitigation Measure 4.9.2c would reduce the impact of night lighting to a less-than-significant level.

ALTERNATIVES

As discussed at the beginning of this chapter, the following describes potential effects and recommended mitigation measures for each alternative to the proposed action. Alternatives to the proposed action include various alternate transmission line routes (Alternatives 2 through 6) and the No Action alternative (Alternative 7).

For Alternatives 2 through 6, potential impacts associated with the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of potential impacts along these portions of the transmission line are not repeated under each alternative discussion. The analysis of these impacts focuses on the effects that would be different from those identified for the proposed action and references are provided for those segments that have been previously discussed under the proposed action or a preceding alternative discussion.

Figure 4.9-5: Existing View and Visual Simulation of Proposed Action from KOP #20



Simulation of proposed transmission line route (Segment A2) and alternative (Segment A3) as seen from Schochin Butte (Lava Beds National Monument) looking south towards Glass Mountain.

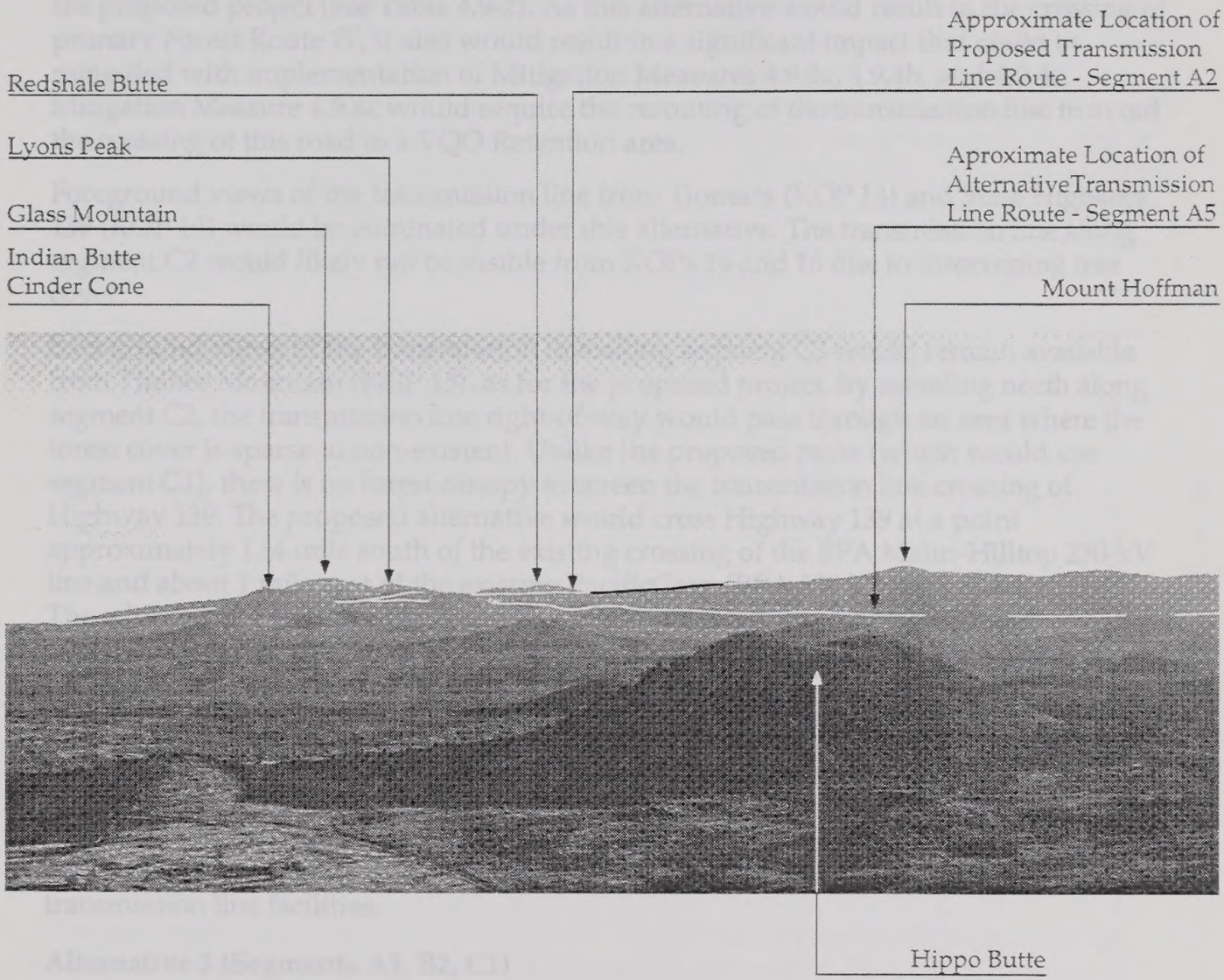


Existing view from Schonchin Butte (Lava Beds National Monument) looking south towards Glass Mountain.

Note: The simulation above is a copy of a photographic file. Therefore, the degree of clarity and contrast presented is somewhat reduced as compared with the original image.

SOURCE: 2M Associates

Figure 4.9-6: Illustrative Schematic of Transmission Line Segments from Key Observation Point #20/Schonchin Butte Lookout



SOURCE: 2M Associates

Alternative 2 (Segments A1, A2, B1, C2)

Wellfield and Power Plant: Visual impacts of the wellfield and power plant as seen from KOPs, under this alternative, would be the same as described above for the proposed action (Alternative 1), as the wellfield and power plant site would occur on the same site as identified for the proposed action.

Transmission Line: This alternative would have the same impacts to the Medicine Lake area and the Lava Beds National Monument as the proposed route, as segments A1, A2, and B1 would also be used for this alternative. This alternative would involve five crossings of inventoried sensitive routes of travel, which would be one less than for the proposed project (see Table 4.9-2). As this alternative would result in the crossing of primary Forest Route 77, it also would result in a significant impact that could be mitigated with implementation of Mitigation Measures 4.9.4a, 4.9.4b, and 4.9.4c. Mitigation Measure 4.9.4c would require the rerouting of the transmission line to avoid the crossing of this road in a VQO Retention area.

Foreground views of the transmission line from Tionesta (KOP 14) and State Highway 139 (KOP 16) would be eliminated under this alternative. The transmission line along segment C2 would likely not be visible from KOPs 14 and 16 due to intervening tree cover.

Background views of the transmission line along segment C2 would remain available from Timber Mountain (KOP 15), as for the proposed project. By traveling north along segment C2, the transmission line right-of-way would pass through an area where the forest cover is sparse to non-existent. Unlike the proposed route (which would use segment C1), there is no forest canopy to screen the transmission line crossing of Highway 139. The proposed alternative would cross Highway 139 at a point approximately 1/4 mile south of the existing crossing of the BPA Malin-Hilltop 230-kV line and about 1 mile east of the existing PacificCorp/BPA 500 kV transmission line. The addition of a third transmission line within the Highway 139 view would somewhat increase the effect of transmission lines along this section of the highway.

The visual impacts of Alternative 2, associated with segment C2, would be considered adverse but not significant as the line would be consistent with the VQOs in this area. Implementation of Mitigation Measure 4.9.4a would reduce this adverse impact. While the transmission line facilities would remain evident, they would be consistent with the VQOs of Partial Retention and Modification. The facilities also would not strongly contrast with the characteristic landscape features in this area, which include existing transmission line facilities.

Alternative 3 (Segments A1, B2, C1)

Wellfield and Power Plant: Visual impacts of the wellfield and power plant as seen from KOPs, under this alternative, would be the same as described above for the proposed action (Alternative 1), as the wellfield and power plant site would occur on the same site as identified for the proposed action.

Transmission Line: This alternative would involve the same impacts to the Medicine Lake area (related to segment A1) as the proposed alternative. This alternative would

Table 4.9-2: Road Crossings Required for Each Alternative, Including the Proposed Action

Roads	Alternative 1 (Proposed Action)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Major Travel Routes (Sensitivity Level 1)							
Primary Forest Road 49	1	1	1	1	1	1	0
Primary Forest Road 77	1	1	1	1	0	0	0
Primary Forest Road 97	1	0	3	2	1	0	0
Primary Forest Road 10	1	1	1	1	1	1	0
State Highway 139	1	1	1	1	1	1	0
Minor Travel Routes (sensitivity Level II)							
44N01	1	1	0	0	1	1	0
43N14	0	0	1	1	0	0	0
Total Road Crossings	6	5	8	7	5	4	0

SOURCE: MHA Environmental Consulting, Inc. and 2M Associates, 1997.

have the same visual impacts, related to segment C1, as identified for the proposed action. This alternative would involve eight crossings of inventoried sensitive routes of travel, which would be two more than the proposed project (see Table 4.9-2). As this alternative would result in the crossing of primary Forest Route 77, it also would result in a significant impact that could be mitigated with implementation of Mitigation Measures 4.9.4a, 4.9.4b, and 4.9.4c. Mitigation Measure 4.9.4c would require the rerouting of the transmission line to avoid the crossing of this road in a VQO Retention area.

The route along segment B2 would cross and would be seen from the Lyons Peak Loop Road (Forest Roads 44N53 and 44N99) at two locations, where it crosses Primary Forest Route 97 (KOP 13) as well as from Forest Road 43N14. Segment B2 would also be visible from the Timber Mountain Fire Lookout (KOP 15). As for the proposed action, the transmission line would not be visible from Lava Beds National Monument KOPs. Although this alternative avoids segment A2, which crosses along the northern side of the Medicine Lake Highlands, segment A2 would not be visible from Lava Beds KOPs. As shown in the visual simulation prepared from Schonchin Butte (KOP 20), see Figure 4.10.5, none of the transmission line segments, including segment A2, would be visible with the naked eye from this location, due to the distance.

The visual impacts of Alternative 3, associated with segment B2, would be considered significant. Implementation of Mitigation Measures 4.9.4a and 4.9.4b where the transmission line crosses Forest Roads 44N53, 44N99, 43N14, and Primary Forest Route 97 (KOP 13) would reduce this impact to a less-than-significant level. While the transmission line facilities would remain evident, they would be consistent with the VQOs of Partial Retention and Modification. The facilities also would not strongly contrast with the characteristic landscape features in this area.

It should also be noted that after mitigation this alternative would not be as visually evident from Timber Mountain (KOP 15) as for the proposed route, as segment B2 passes around the south side of the Medicine Lake Highlands and would be mostly shrouded by tree cover and topography from KOP 15.

Alternative 4 (Segments A1, B2, C2)

Wellfield and Power Plant: Visual impacts of the wellfield and power plant as seen from KOPs, under this alternative, would be the same as described above for the proposed action (Alternative 1), as the wellfield and power plant site would occur on the same site as identified for the proposed action.

Transmission Line: This alternative would involve the same impacts to the Medicine Lake area (related to segment A1) as the proposed alternative. This alternative would generally have the same visual impacts, related to segments B2 and C2, as identified above for Alternatives 3 and 2, respectively. This alternative would involve seven crossings of inventoried sensitive routes of travel, which is one more than the proposed project (see Table 4.9-2). As this alternative would result in the crossing of primary Forest Route 77, it also would result in a significant impact that could be mitigated with 4.9.4a, 4.9.4b, and 4.9.4c. Mitigation Measure 4.9.4c would require the rerouting of the transmission line to avoid the crossing of this road in a VQO Retention area.

Alternative 5 (Segments A3, B1, C1)

Wellfield and Power Plant: Visual impacts of the wellfield and power plant as seen from KOPs, under this alternative, are the same as described above for the proposed action (Alternative 1), as the wellfield and power plant site would occur on the same site as identified for the proposed action.

Transmission Line: This alternative would avoid the visual impacts to the Medicine Lake area (related to segment A1). Specifically, Alternative 5 would avoid the unavoidable significant visual effects that would occur under the proposed project at KOPs 1-5 at Medicine Lake. The visual impacts of segments B1 and C1 would generally be the same as described for the proposed action.

This alternative would involve five crossings of inventoried sensitive routes of travel (see Table 4.9-2). The alternative would avoid the crossing of two sensitive travel routes in the Medicine Lake area. This alternative would avoid the use of segment A1 and the need for the Primary Forest Route 77 crossing and therefore would avoid the need to reroute the transmission line to avoid the crossing of this road in a VQO Retention area that would occur with the proposed project.

Segment A3 passes through an area with a VQO of Retention and crosses Forest Road 44N54. This segment would be visible from Forest Road 44N54 and would be visible from Primary Forest Route 49 in the vicinity of the crossings of these roads. Mitigation Measures 4.9.4a and 4.9.4b would minimize the visibility of the transmission line at its crossings with Forest Road 44N54 and Primary Forest Route 49. With this mitigation, the line would be consistent with the VQO of Retention as seen from the 44N54 road crossing. The visibility of the line from Primary Forest Route 49, would remain partially visible and would result in a long-term inconsistency with the VQO of Retention at this road crossing. Therefore, this is considered a significant impact. Implementation of Mitigation Measures 4.9.4a, 4.9.4b, and 4.9.4c would reduce this impact to a less-than-significant level. For this alternative, the text of Mitigation Measure 4.9.4c shall be replaced with the following mitigation language.

- Reroute the transmission line and utility corridor along segment A3 slightly north of the proposed alignment to avoid crossing Primary Forest Route 49 in a VQO Retention area. This shall be accomplished by rerouting segment A3 just north of Fourmile Hill (approximately 0.4 miles from the power plant), northeast for approximately 0.25 miles to Primary Forest Route 49. Once this road is crossed, the line shall be redirected back towards the southeast where it shall continue to follow the proposed alignment of segment A3. Rerouting the transmission line and utility corridor in accordance with this measure shall result in the crossing of Primary Forest Route 49 in a VQO of Partial Retention.

After crossing Route 49, the transmission line along Segment A3 would cross along the northern side of the Medicine Lake Highlands. It is unlikely, however, this segment would be readily visible from any location within the Lava Beds National Monument. As shown in the visual simulation prepared from Schonchin Butte (KOP 20), see Figure 4.10.5, none of the alternative transmission line segments, including segment A3, would be visible with the naked eye from this location, due to the distance.

Alternative 6 (Segments A3, B1, C2)

Wellfield and Power Plant: Visual impacts of the wellfield and power plant as seen from KOPs, under this alternative, would be the same as described above for the proposed action (Alternative 1), as the wellfield and power plant site would occur on the same site as identified for the proposed action.

Transmission Line: Similar to Alternative 5, this alternative would avoid the visual impacts to the Medicine Lake area (related to segment A1). Specifically, Alternative 6 would avoid the unavoidable significant visual effects that would occur under the proposed project at KOPs 1-5 at Medicine Lake. The visual impacts of segment A3 would be the same as described above for Alternative 5. The visual impacts of segment B1 would be the same as described for the proposed action. The visual impact of segment C2 would be generally the same as described above for Alternative 2.

This alternative would involve four crossings of inventoried sensitive routes of travel (see Table 4.9-2). The alternative would avoid the crossing of two sensitive travel routes in the Medicine Lake area. This alternative would avoid the use of segment A1 and the need for the Primary Forest Route 77 crossing and therefore would avoid the need to reroute the transmission line to avoid the crossing of this road in a VQO Retention area that would occur with the proposed project. As for Alternative 5, a significant impact would occur, however, with the crossing of Route 49 along segment A3. Mitigation Measures 4.9.4a, 4.9.4b, and 4.9.4c would reduce this impact to a less-than-significant level. The text of Mitigation Measure 4.9.4c shall be replaced, as described above for Alternative 5.

Alternative 7 (No Action)

The No Action alternative would avoid all the significant and adverse visual impacts identified for the proposed action (Alternative 1) and the other alternatives. No visual change in the characteristic landscape of the project vicinity would occur with this alternative.

4.10 Plans and Policies

KEY ISSUES

The key plans and policies issues identified and evaluated in this section relate to the effects of the project on released roadless areas and associated policies related to these areas. The effects are evaluated in Impacts 4.10.1 and 4.10.2.

SIGNIFICANCE CRITERIA

According to Appendix G of the CEQA Guidelines, the proposed project would be considered to have a significant effect if it would result in the following:

- Cause an actual physical change to the environment as a result of a conflict with adopted environmental plans and goals for the area in which it is located.
- Result in a substantial alteration of the planned land use of an area.

METHODOLOGY

The proposed project was analyzed for consistency with applicable plans and policies. Documents reviewed included:

- Klamath National Forest Land and Resource Management Plan (LRMP) (USFS 1995) and associated EIS (USFS 1995)
- Modoc National Forest Land and Resource Management Plan (USFS 1991a) and associated EIS (USFS 1991b)
- Northwest Forest Plan (USFS and BLM 1994a)

Because the management policies of the Northwest Forest Plan have been incorporated into both the Klamath and Modoc National Forest LRMPs, the consistency of the proposed project with these policies is evaluated in the two LRMP discussions. Consistency of the proposed project with land use stipulations outlined in Calpine's Federal geothermal leases and with the Siskiyou and Modoc County General Plans was also reviewed.

PROPOSED ACTION (ALTERNATIVE 1)

4.10.1 Consistency with Klamath National Forest Land and Resource Management Plan

The proposed project would be consistent with the standards and guidelines identified in the Klamath National Forest LRMP as amended. As discussed in Chapter 1, the Klamath National Forest LRMP would be amended to revise the wording of standard #24-25 to be consistent with the standard's intent to comply with the American Indian Religious Freedom Act of 1978. The Klamath National Forest LRMP would also be amended to include standards and guidelines for the management of utility corridors if the proposed project is approved. Both the Klamath and the Modoc Forest LRMPs would be amended to designate and approve the transmission line route as a utility corridor.

Land Management Designations: The proposed project would be consistent with land management designations within the Klamath National Forest. The proposed project

would be located within or adjacent to four types of management areas (General Forest, Retention, Partial Retention, and Special Interest Areas) and is also within the Adaptive Management Area. These management areas do not limit geothermal exploration and development, utility corridors, or road construction. The proposed project would be consistent with policies requiring mitigation of visual impacts.

Released Roadless Areas: The project would also be consistent with the Klamath LRMPs standard and guideline, which states released roadless areas would be managed according to the objectives of the management area in which they occur. Under the proposed project, segment A2 of the transmission line would pass through the Modoc National Forest portion of the Mt. Hoffman roadless area, which totals 11,300 acres, 500 of which are within the Klamath National Forest. The impacts of the transmission line on the Mt. Hoffman released roadless area are analyzed in Section 4.11 of this EIS/EIR. As concluded in this section, the transmission line would not substantially alter the character of this released roadless area.

Geothermal Development: The project would comply with policies for management of mining and geothermal activities, including submittal of a Plan of Operation and Notice of Intent, development of a reclamation plan, and limited surface occupancy for residential use and indirect support of mining and energy mineral operations. Reasonable means of access that would be consistent with management objectives would also be provided. No project activities would occur within a Special Interest Area.

Utility Corridors: The Klamath Forest LRMP indicates that utility corridors may be located on forest lands if private land cannot be reasonably used, as long as the utility corridors do not conflict with stated management objectives for the forest area. Construction of a portion of the proposed transmission line within the Klamath National Forest would be consistent with this policy. The location of the transmission line is constrained by the location of the geothermal resource, which makes it impossible to locate the transmission line on private land. The transmission line would not conflict with any management objectives for the areas it would pass through.

Road Development: Construction of new roads as part of the proposed project would be consistent with road development policies outlined in the Klamath LRMP. New roads would be constructed in accordance with USFS road management objectives. As part of project decommissioning, access roads associated with the transmission line would be revegetated and recontoured, as necessary, to return the areas as much as possible to pre-project conditions. Impacts associated with constructing proposed new roads are evaluated throughout this EIS/EIR (see Sections 4.2, Geology and Soils; 4.5, Cultural Resources; 4.7, Vegetation; 4.8, Wildlife; 4.9, Visual Resources; 4.11, Land Use and Recreation, and 4.13, Air Quality).

Special Status Species: The proposed project would be consistent with Klamath Forest LRMP policies stating that project areas should be surveyed for the presence of sensitive species including all special-status species, as defined on pages 3-71 and 3-97 before project implementation. As part of the environmental review for the proposed action, several surveys have been conducted at the power plant and wellfield area and along the proposed and alternative transmission line segments. In addition, pre-construction

surveys for special status species would be required for the selected transmission line route if the project is approved (see Section 4.8, Wildlife).

Visual Resources: With mitigation, which is an integral part of the project, the proposed project would be consistent with policies in the Klamath National Forest LRMP regarding visual resources. Where transmission line segment A1 would be visible from Primary Forest Route 77 and other Medicine Lake area KOPs it would be located outside VQO Retention areas to reduce the visibility of the line from various locations as a mitigation measure (see Section 4.9).

Air Quality: The proposed project would be consistent with Klamath Forest policies related to air quality. The project would be in compliance with the Clean Air Act, and would meet air quality standards established by the California Air Resources Board and Siskiyou County Air Pollution Control District. In addition, the project would comply with forest policies to implement control measures to reduce dust generation (see Section 4.13, Air Quality).

Cultural Resources: As part of the environmental review of the proposed project, cultural resources at the power plant, wellfield, and along the transmission line segments have been inventoried, and project impacts on these resources have been analyzed (see Sections 3.5 and 4.5, Cultural Resources). In addition, pre-construction surveys for cultural resources would be required for the selected transmission line route if the project is approved. The sites would be evaluated for National Register eligibility and mitigation implemented, as appropriate, through the Section 106 process. The proposed project would be consistent with the Klamath LRMP policies to protect cultural resources (see Section 4.5, Cultural Resources).

Native American Rights: The Klamath National Forest LRMP standard regarding protection of Native American values states:

> "Protect traditional Native American rights and practices (Public Law (PL) 95-341) to insure the integrity of the site and to assure that use will continue to occur and will not be impaired." (Standard 24-25)

The intent of this standard is to comply with the American Indian Religious Freedom Act (AIRFA), which states "...the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian... including but not limited to access to sites, use and possession of sacred objects, and freedom to worship through ceremonials and traditional rites." (PL 95-341; 42 USC 1978)

The USFS has conducted extensive consultations with the local tribes to identify tribal concerns about the proposed project and to protect Native American rights; also, the USFS has conducted several meetings with the tribes regarding the proposed project and the tribes have stated that they are opposed to the project (see Section 3.6, Traditional Cultural Values).

In addition to meetings between the USFS and the tribes, the interdisciplinary EIS/EIR team ethnographer conducted 31 interviews with tribal members. The interviews were conducted to identify traditional sites and uses in the project region, to understand Native American concerns about the proposed project, and to identify how the tribes

would be affected by the project. The project has been designed and mitigation has been defined to minimize the effects of the proposed project on the environment and on local tribes. The American Indian rights, including those to access sites and to conduct ceremonies, would not be affected by the proposed project.

Several members of the tribes have stated that the proposed project would affect the spirituality of the Medicine Lake Highlands and would affect their religious practices. The proposed project would not preclude access to the Medicine Lake Highlands or specific traditional sites. The project would not prohibit tribal members from conducting traditional activities. However, elements of the project would be visible and audible at sites in the Medicine Lake Highlands. Tribal members may choose to not use sites in the project region and their use might be affected by sights, sounds, or smells of the project.

If tribal members choose to discontinue use of sites as a result of project-generated noise or changes in visible elements, the proposed project would be inconsistent with the current Klamath LRMP standard 24-25, as written. The project would, however, be consistent with the intent of the standard to comply with AIRFA and the protection of American Indian rights of freedom of religion.

This potential inconsistency with the standard (but not the intent of the standard) would not result in a physical change to the environment or result in a substantial alteration of planned land use. Should the proposed project be approved, this standard will be amended. If tribal members' planned land use of the area changed as a result of the project, this would be considered significant under CEQA. Impacts to American Indians are considered significant (see Section 4.6, Traditional Cultural Values for further discussion of project effects on Native Americans, traditional uses and values, and mitigation).

Standard 24-25 is unenforceable as continued use of traditional sites can not be assured. The intent of the standard was to provide the protections specified under PL 95-341, but not to provide more rights than the law allows. The standard was written in error. A revision of forest-wide standard #24-25 as an amendment to the LRMP would be approved if the proposed project or any of the action alternatives is approved. The standard would be revised to state:

> "Protect traditional Native American cultural and religious uses and practices consistent with PL 95-341, American Indian Religious Freedom Act of 1978."

The amendment would make the Klamath National Forest LRMP consistent with PL 95-341 (AIRFA) and the Modoc National Forest LRMP. The amendment would correct an unenforceable policy, the concept that the Klamath National Forest can require the Native American Community to use an area. The Klamath National Forest would provide protection under PL 95-341 (AIRFA) that will protect the physical integrity of the site and not prevent access. The level of protection would not change. The effect of the revision of Klamath Forest standard 24-25 is addressed in Section 4.6, Traditional Cultural Values, and 4.17 Cumulative Effects. While this amendment may be considered significant under CEQA, it would be a non-significant plan amendment and not significant under NEPA, which governs Federal actions. The proposed project would be consistent with the AIRFA and with the revised standard.

Mitigation Measures

The mitigation measures in Section 4.6, Traditional Cultural Values and throughout the document, are designed to minimize the effects of the project on Native Americans, but may not fully mitigate effects. The following mitigation measure would eliminate the inconsistency of the proposed project with the Klamath LRMP.

4.10.1a Amend the Klamath LRMP to revise forest-wide standard 24-25 to state: "Protect traditional Native American cultural and religious uses and practices consistent with PL 95-341, American Indian Religious Freedom Act of 1978." (C)

Significance After Mitigation

Less than significant after the Klamath LRMP is amended. The impact would remain significant if the LRMP is not amended.

4.10.2 Consistency with Modoc National Forest Land and Resource Management Plan

The proposed project would be consistent with the management prescriptions of the Modoc National Forest LRMP. The five types of management areas (timber managed for partial retention VQO, timber managed for modification VQO, rangeland, and range-forage) that the transmission line would pass through do not restrict geothermal exploration and development, utility corridors, or road construction. The Modoc LRMP would be amended to designate and approve the transmission line route as a utility corridor.

Released Roadless Areas: Under the proposed project, segment A2 of the transmission line would pass through the Mt. Hoffman released roadless area, which totals 11,300 acres, 10,800 of which are within the Modoc National Forest. The location of the proposed transmission line within the Mount Hoffman released roadless area would affect the mostly roadless character of the area. This effect would not be inconsistent with any policies in the Modoc National Forest LRMP. The USFS policy requires preparation of an EIS for any proposal that would substantially alter the undeveloped character of a 5,000-acre or larger roadless area. As discussed above, the impacts of the transmission line on the Mt. Hoffman released roadless area are analyzed in Section 4.11 of this EIS/EIR. As concluded in this section, the transmission line would not substantially alter the character of this released roadless area.

Geothermal Development: The proposed project would be consistent with Modoc Forest policies to accommodate the development of new energy sources, including geothermal development. The proposed project has been designed to minimize surface disturbance, which would be consistent with the policy to prohibit unnecessary surface disturbance. The Modoc LRMP requires development of reclamation plans for rehabilitation of the surface and vegetation for energy development projects. Project decommissioning plans would meet this requirement.

Utility Corridors: After approval of the transmission line route for the proposed project, the Modoc National Forest would be required to amend their LRMP to designate this route as a utility corridor. The proposed project would be consistent with all of these standards and guidelines. Due to constraints based on the location of the geothermal resource, it would not be feasible to locate the transmission line within an existing utility corridor, or on private land. The proposed 230-kV transmission line could transmit up to 145 MW, approximately 95 MW more than would be required for

the proposed project. Future geothermal development within the Glass Mountain KGRA could utilize the same transmission line and/or utility corridor, thus reducing the future proliferation of utility corridors in accordance with Modoc Forest policies.

The Modoc Forest LRMP identifies several standards and guidelines related to the use of forest lands for utility corridors. Consistent with LRMP standards and guidelines, the proposed transmission line would be sited to avoid critical habitat for special-status species (see Sections 4.7 Vegetation and 4.8 Wildlife), semi-primitive recreation areas (see Section 4.11 Land Use and Recreation), Special Interest Areas (see Section 4.2, Geology and Soils), and Native American religious areas (see Section 4.6, Traditional Cultural Values). Since there are no designated wilderness areas or Research Natural Areas in the project vicinity, the proposed action would not affect these areas, and would not conflict with standards and guidelines for these areas.

Road Development: The Modoc Forest LRMP states that new roads should be built to the lowest standard commensurate with intended use. The proposed project would be consistent with this policy (see Section 4.12, Transportation). Roads would be constructed or improved only to the degree necessary to accommodate project activities.

Cultural Resources: As part of the environmental review of the proposed project, cultural resources at the power plant, wellfield, and along the transmission line segments have been inventoried, and project impacts on these resources have been analyzed (see Sections 3.5 and 4.5, Cultural Resources). In addition, pre-construction surveys for cultural resources would be required for the selected transmission line route if the project is approved. The sites would be evaluated for National Register eligibility and mitigation implemented, as appropriate, through the Section 106 process. The project would be consistent with Modoc Forest policies for protection of cultural resources. The proposed project would be consistent with the Modoc Forest LRMP standards to protect Native American rights and practices.

Visual Resources: Prior to mitigation the proposed transmission line, along segment A1, would result in inconsistencies with the VQO of Retention that exist in portions of the Medicine Lake area (see Section 4.9, Visual Resources). As the facilities would be visually evident within a Retention area, inconsistencies with the VQO outlined in the Modoc National Forest LRMP would occur. Implementation of identified visual resources mitigation measures would avoid these inconsistencies as the facilities would be relocated outside of VQO Retention areas. Additionally, mitigation measures would reduce the visibility of project facilities (see Section 4.9, Visual Resources, for mitigation measures).

Water Resources: Since the proposed project would not result in the loss or diversion of water flow in the project vicinity (see Section 4.4, Hydrology), the proposed project would not conflict with hydrology policies contained in the Modoc National Forest LRMP. The proposed project would also comply with Modoc Forest air quality policies requiring implementation of dust abatement procedures for construction activities.

Mitigation Measures

No mitigation measures are recommended.

4.10.3 Consistency with Lease Stipulations

The proposed action would be consistent with the surface occupancy restrictions for Sections 21, 28, and 29 that are stipulated in Calpine's geothermal leases CA21924 and CA21926. No project facilities would be located in the areas where surface occupancy is restricted due to goshawk nesting habitat. Four of the proposed well pads — P-2, I-1, I-2, and I-3 — would be located in areas with surface occupancy restrictions related to visual quality. As indicated in Appendix D and described in Section 4.9, some of the well pads would be located in Retention areas, which means that development should not be visually evident. The proposed wellfield and power plant would not have significant impacts on visual qualities in these areas (see Section 4.9, Visual Resources); therefore, the wells could be located in these areas. Since the proposed project would not use existing surface water on the leases and would not result in surface disturbance within 700 feet of water sources on the leases, (see Section 4.4, Hydrology) the proposed action would be consistent with the lease stipulation regarding natural water sources.

The proposed project would be consistent with stipulations of Calpine's Federal geothermal leases, and the effect would not be significant.

Mitigation Measures

No mitigation measures are recommended.

4.10.4 Consistency with Siskiyou County General Plan

The Siskiyou County General Plan does not include any applicable plans or policies for the proposed project; therefore, the proposed project would not be inconsistent with this plan and the project effects would not be significant.

Mitigation Measures

Since the proposed project would not be inconsistent with the Siskiyou County General Plan, no mitigation measures are recommended.

4.10.5 Consistency with Modoc County General Plan

The Modoc County General Plan identifies a policy to review plans for transmission lines or other facilities which are undertaken by agencies exempt from County regulations in order to provide focus for County and public input. Consistent with this policy, the Modoc County Planning Department has been consulted during the project planning and environmental review process for the proposed project. The proposed project would be consistent with the Modoc County General Plan.

Mitigation Measures

Since the proposed project would not be inconsistent with the Modoc County General Plan, no mitigation measures are recommended.

ALTERNATIVES

The following discussion describes the consistency with applicable plans and policies and recommended mitigation measures for each alternative to the proposed action. For Alternatives 2 through 6, consistency with plans and policies regarding the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would

each use at least a portion of the proposed transmission line route, and analysis of the consistency of these portions of the transmission line are not repeated under each alternative discussion. The analysis of these impacts focuses on the effects that would be different from those identified for the proposed action.

Alternative 2 (Segments A1, A2, B1, and C2)

Alternative 2 is the same as the proposed project, except that transmission line segment C1 would be replaced by segment C2. Alternative 2 would be consistent with the applicable plans and policies, with the implementation of Mitigation Measure 4.10.1a and visual resource mitigation measures identified in Section 4.9. As for the proposed project, the inconsistencies with the visual resource policies in the Klamath and Modoc National Forest LRMPs and a potential inconsistency with Klamath National Forest policies to assure that Native American use will continue, would be avoided with the implementation of these measures. The other effects of this alternative would not be significant for the same reasons discussed under the proposed action.

Under Alternative 2, the transmission line along segment C2 would pass through the southern portion of both the 25,400-acre Lavas and 12,900-acre Dobie Flat released roadless areas. The impacts of this alternative transmission line route on these released roadless areas are analyzed in Section 4.11 of this EIS/EIR. As concluded in this section, the transmission line would not substantially alter the character of these released roadless areas.

Alternative 3 (Segments A1, B2, and C1)

Alternative 3 differs from the proposed action by the replacement of transmission line segments A2 and B1 with segment B2. This alternative would be consistent with the applicable plans and policies with the implementation of Mitigation Measure 4.10.1a and visual resource mitigation measures identified in Section 4.9. As for the proposed project, the inconsistencies with the visual resource policies in the Klamath and Modoc National Forest LRMPs and a potential inconsistency with Klamath National Forest policies to assure that Native American use will continue, would be avoided with the implementation of these measures. The other effects of this alternative would not be significant for the same reasons discussed under the proposed action.

Alternative 3 would not include segment A2; therefore, the transmission line would not pass through the Mt. Hoffman roadless release area. Under this alternative, a portion of segment B2 would pass through an area of late-successional forest and therefore would be subject to a different set of management policies under the Northwest Forest Plan. Alternative 3 would be consistent with the Northwest Forest Plan standards and guidelines for Managed Late-Successional Areas. The Plan states that a project addressing public needs, including power lines, may be approved when adverse impacts to late-successional areas can be minimized and mitigated. This alternative would not significantly affect late-successional areas; further, biological mitigation measures have been identified to reduce impacts that would occur under this alternative (see Section 4.8, Wildlife). Impacts would not be significant and no additional mitigation measures are recommended for this alternative.

Alternative 4 (Segments A1, B2, and C2)

Alternative 4 would be the same as Alternative 3 except that segment C2 would be used rather than segment C1. Alternative 4 would be consistent with the applicable plans and policies with the implementation of Mitigation Measure 4.10.1a and visual resource mitigation measures identified in Section 4.9. As for the proposed project, the inconsistencies with the visual resource policies in the Klamath and Modoc National Forest LRMPs and a potential inconsistency with Klamath National Forest policies to assure that Native American use will continue, would be avoided with the implementation of these measures. The other effects of this alternative would not be significant for the same reasons discussed under the proposed action.

Alternative 4 would not include segment A2, and the transmission line would not pass through the Mt. Hoffman roadless release area. However, segment C2 of the transmission line would pass through a portion of both the Lavas and Dobie Flat released roadless areas. The impacts of this alternative transmission line route on these released roadless areas are analyzed in Section 4.11 of this EIS/EIR. As concluded in this section, the transmission line would not substantially alter the character of these released roadless areas.

As with Alternative 3, under Alternative 4 a portion of segment B2 would pass through an area of late-successional forest and therefore would be subject to a different set of management policies under the Northwest Forest Plan. For the reasons described above, Alternative 4 would be consistent with the Northwest Forest Plan standards and guidelines for Managed Late-Successional Areas. Biological mitigation measures have been identified to reduce impacts that would occur to these areas under this alternative (see Section 4.8, Wildlife). No additional mitigation measures are recommended for this alternative.

Alternative 5 (Segments A3, B1, and C1)

Alternative 5 would be consistent with the applicable plans and policies with the implementation of Mitigation Measure 4.10.1a and visual resource mitigation measures identified in Section 4.9. As for the proposed project, the inconsistencies with the visual resource policies in the Klamath and Modoc National Forest LRMPs and a potential inconsistency with Klamath National Forest policies to assure that Native American use will continue, would be avoided with the implementation of these measures. Inconsistencies with VQOs in the Medicine Lake area would not occur with this alternative as segment A1 would not be used. Segment A3, however, would also result in an inconsistency with the VQO of Retention in the vicinity of the Primary Forest Route 49 crossing. Visual resource mitigation measures identified in Section 4.9 would avoid this inconsistency.

Under Alternative 5, segment A2 would not be developed, and the transmission line would not pass through any released roadless areas. As concluded in Section 4.11, the transmission line would not substantially alter the character of these released roadless areas. The other effects of this alternative would not be significant for the same reasons discussed under the proposed action.

Alternative 6 (Segments A3, B1, and C2)

Alternative 6 would be consistent with the applicable plans and policies with the implementation of Mitigation Measure 4.10.1a and visual resource mitigation measures identified in Section 4.9. As for the proposed project, the inconsistencies with the visual resource policies in the Klamath and Modoc National Forest LRMPs and a potential inconsistency with Klamath National Forest policies to assure that Native American use will continue, would be avoided with the implementation of these measures. As for alternative 5, inconsistencies with VQOs in the Medicine Lake area would not occur with this alternative as segment A1 would not be used. Segment A3, however, would also result in an inconsistency with the VQO of Retention in the vicinity of the Primary Forest Route 49 crossing. Visual resource mitigation measures identified in Section 4.9 would avoid this inconsistency.

Alternative 6 would not include segment A2, and the transmission line would not pass through the Mt. Hoffman roadless release area. Segment C2 of the transmission line would, however, pass through a portion of both the Lavas and Dobie Flat released roadless area. The impacts of this alternative transmission line route on these released roadless areas are analyzed in Section 4.11 of this EIS/EIR. As concluded in this section, the transmission line would not substantially alter the character of these released roadless areas. No mitigation measures would be necessary for this alternative.

Alternative 7 (No Action)

Alternative 7, the No Action alternative, would not conflict with any applicable plans or policies of the planning documents discussed above. No mitigation measures would apply to this alternative.

4.11 Land Use and Recreation

REGULATORY FRAMEWORK

The USFS manages its lands to allow for multiple uses to occur while still providing for resource management and protection. On the Klamath and Modoc National Forests, this multiple-use mission allows for a variety of land uses, including recreation, commercial timber harvesting, grazing, mining, and energy development. The Klamath and Modoc National Forests provide for the management of forest lands through guidelines and regulations set forth in their respective LRMPs (USFS 1995; USFS 1991a). Policies contained in these plans that are relevant to the proposed action are described and evaluated in Sections 3.10 and 4.10, Plans and Policies.

As described in Section 3.11, the USFS manages its lands using the Recreation Opportunity Spectrum (ROS) classification system. The ROS provides a framework for defining the types of outdoor recreation opportunities the public might desire and identifies that portion of the spectrum a given forest area might be able to provide. The ROS allocations provide overall guidance to manage specific areas in a fashion that are compatible with the assigned allocation. The four ROS allocations are:

- Roaded Natural
- Semi-Primitive Motorized
- Semi-Primitive Nonmotorized
- Primitive

Most areas in the vicinity of the proposed project have a ROS allocation of Roaded Natural (see Figure 3.11-2). Other ROS allocations in the project vicinity include:

- Mount Hoffman released roadless — Semi-Primitive Non-Motorized
- Medicine Lake Lava Flow — Primitive
- Glass Mountain Lava Flow — Primitive

KEY ISSUES

The key land use and recreation issues identified and evaluated in this section relate to the effects of the project on developed recreational and residential areas on Medicine Lake and snowmobiling. These effects are evaluated in Impacts 4.11.1, 4.11.2, 4.11.3, 4.11.4, and 4.11.6.

SIGNIFICANCE CRITERIA

According to Appendix G of the CEQA Guidelines, the proposed project may have a significant effect on the environment if it would:

- Result in a substantial alteration of the present land use of an area
- Disrupt or divide the physical arrangement of an established community
- Conflict with established land uses including recreational, educational, religious, or scientific uses in an area (see Section 4.6, Traditional Cultural Values for a discussion of the project's potential effect on American Indian religious uses of the area)

The following professional standards indicate that project effects on recreation resources would also be considered significant if:

- The location of proposed geothermal facilities would significantly alter regional recreational use patterns and/or preclude existing recreation uses from taking place in the region
- An inconsistency with an existing ROS designation for an area would occur that would result in a significant deterioration of the recreational experience designated as appropriate for that ROS
- The sights, sounds, or odors emanating from the project would be sufficient, individually or combined, to detract substantially from the Forest visitor's recreation experience

PROPOSED ACTION (ALTERNATIVE 1)

4.11.1 Effect on the Overall Recreation Experience

Construction, operation, and decommissioning of the proposed project may affect the general recreation experience in the vicinity by affecting the overall character of the area as defined by its sights, sounds, and air quality. This would be considered an adverse, but not significant impact, as the project would not substantially detract from the overall recreation experience. Once project decommissioning is completed, developed areas would be returned to pre-development conditions, thereby removing project effects.

Construction: During project construction, the overall recreation experience of visitors to various areas in the vicinity of the project could be affected. The overall recreation experience could be affected by a combination of views of project construction activities, as well as noise, dust, and odors from these activities. However, construction of the proposed project would not be expected to significantly affect the overall recreation experience of recreationalists in the project vicinity due primarily to the limited exposure of users to construction activities.

As discussed in Section 4.9, Visual Resources, project construction would not significantly affect views in the area. Noise from construction activities, while audible at various locations in the Forest, would be short-term and significant (see Section 4.14, Noise). Dust generated by construction activities would be controlled but could result in short-term significant impacts immediately adjacent to construction activities (see Section 4.13, Air Quality). In addition, any exposure of recreational users to hydrogen sulfide odors during well venting and testing at the wellfield would be temporary (see Section 4.13, Air Quality).

Construction activities at the proposed wellfield and power plant area would not be expected to be significantly noticeable to recreational users. This area does not serve as a recreational destination point, and most visitors simply pass through the area if they are in the vicinity at all. In the summer, the most likely exposure of construction activities at the proposed wellfield and power plant area would be to motorists passing by on Forest Road 44N54 or Primary Forest Route 49. Since these motorists would pass the wellfield and power plant area in a matter of seconds, project construction would not be expected to have much of an effect on their overall recreation experience.

Hunters, hikers, and other recreationalists may also occasionally use the area around the wellfield and power plant area during the summer months. Any recreational user that is bothered or annoyed by project views, noise, dust, or odors at this location can move out of the vicinity or make a decision not to hike or hunt in proximity to this site. The visitor's ability to modify plans to avoid activities that may be perceived as bothersome or annoying would minimize the negative effects of the project on the overall recreation experience.

During the winter months, snowmobilers use the vicinity of the wellfield and power plant area, and there are several groomed trails in the vicinity. However, only limited project construction activities would occur at the wellfield and power plant area during the winter months; due to weather conditions, no well pad or road clearing, well drilling, or major plant construction activities would occur during this period. The primary construction activities that would occur at the wellfield and power plant area during the winter would be installation of internal power plant equipment, such as the turbines and generator that would not be observable to wintertime recreational users.

Construction activities along the proposed transmission line route (especially along segment A1) in the Medicine Lake area would likely have a greater impact on the recreational experience than would occur as a result of wellfield and power plant construction. This effect is due to the fact that segment A1 of the proposed transmission line would be less than 0.5 miles from the north shore of Medicine Lake, which is a developed recreational use area that is a year-round destination point. Visitors may travel into the area and have specific plans to stay in the Medicine Lake area. If such visitors find construction noise or the presence of construction vehicles bothersome or annoying, they cannot as readily change their plans as camping reservations in surrounding areas typically need to be made in advance. The visitor's limited ability to readily modify plans to avoid activities that may be perceived as bothersome or annoying may increase the negative effects of the project on the overall recreation experience in the Medicine Lake area. This potential effect is further discussed in Impact 4.11.2.

Construction noise and dust and the visibility of transmission line construction activities may also affect users in dispersed recreation areas along segments A2, B1, and C1. Similar to wellfield and power plant construction, any recreational user that is bothered or annoyed by transmission line construction can readily move out of the vicinity or make a decision not to hike or hunt in proximity to such activities.

When considered together, project construction-related dust, odor, and noise, and visibility of facilities and construction activities would have a short-term adverse impact on the overall recreation experience. This impact is not considered to be significant as it is expected that construction-phase activities and facility development would not limit recreation use or discourage visitors from coming to the area. However, as the recreation experience is subjective and is based on individual perceptions, some visitors may consider construction activities to have an adverse effect on their recreation experience.

Operation: During project operation, the recreation experience of visitors in various areas could be affected as a result of odors, noise, and the visual presence of facilities.

Impacts on the overall recreation experience due to wellfield and power plant area operation and transmission line operation are described below.

In the immediate vicinity of the wellfield and power plant site, operational noise, odors, and night lighting may be apparent by motorists passing by the site on Primary Forest Route 49 and Forest Road 44N54, or by hunters, hikers, snowmobilers or other recreationalists that may use the immediate area around the wellfield and power plant site. Recreationalists that encounter the wellfield and power plant site during operation would see a range of operation phase activities, including well maintenance, infill well drilling, and cooling tower and well venting steam plumes, as described in detail in Section 4.9, Visual Resources.

Operation of transmission line segment A1 through the Medicine Lake area would result in the visible presence of this facility from a variety of Medicine Lake vantage points (see Section 4.9, Visual Resources). The presence of this portion of the transmission line could negatively affect the recreation experience of some visitors to the area. The periodic presence of steam plumes may also contribute to possible negative visitor perceptions. Project operation would not be expected to result in visible dust or audible noise in the Medicine Lake area (see Section 4.13, Air Quality and Section 4.14, Noise).

When considered together, project operation-related odor, noise, and the visibility of facilities would have an adverse, but not significant, impact on the overall recreation experience. This impact is not considered to be significant as it is expected that operation of proposed facilities would not limit recreation use or discourage visitors from coming to the area. However, as the recreation experience is subjective and is based on individual perceptions, some visitors may consider operation activities to have an adverse effect on their recreation experience.

Decommissioning: Similar to construction, decommissioning of the proposed project would be expected to result in a short-term adverse impact on the recreation experience, related to the presence of noise, dust, and the visibility of decommissioning activities and vehicles. This impact is not considered to be significant as it is expected that decommissioning of proposed facilities would not limit recreation use or discourage visitors from coming to the area. Once all facilities and equipment are removed, adverse effects on the recreation experience would be eliminated.

Mitigation Measures

The impacts of the proposed project on the overall recreation experience would not be significant, and adverse impacts would be reduced by Mitigation Measures 4.12.1a, 4.13.1a, 4.14.2a, and 4.14.2d. In addition, the following measures are recommended to further reduce project impacts on the recreation experience in the project area.

4.11.1a In consultation with the USFS and BLM, Calpine shall develop a public information plan by which the local and general public would be notified of upcoming construction activities and schedules. Calpine shall place appropriate signs in approved locations informing users of the recreation area of the construction activities. (C)

Level of Significance After Mitigation

Less than significant.

4.11.2 Effect on Developed Recreation Use Areas

During construction, operation, and decommissioning of the proposed project, no significant effects to developed recreational uses on the Forests would occur. Construction and decommissioning of transmission line segment A1 may result in the temporary closure of the Medicine Lake Lava Flow Trail within the Medicine Lake RMA, which would be a short-term adverse impact. Operation of the proposed action would not directly impact any facilities within developed recreation areas on the Forests.

Construction: During construction of the proposed transmission line along segment A1, the Medicine Lake Lava Flow Trail within the Medicine Lake RMA may need to be temporarily closed (probably for less than a week). The segment A1 route would cross this trail, and temporary closure of the trail may be necessary to allow for adequate clearance for construction equipment and to ensure that the safety of hikers using this trail would not be compromised. This closure could occur as a result of right-of-way clearance during the first year of construction and as a result of pole erection and wire stringing in the second year of construction. Potential closure of this trail during construction would be a short-term adverse impact. This impact would not be significant as trail access elsewhere in the Medicine Lake area and in surrounding national forest lands would continue to be available during project construction and as this trail closure would be temporary.

No other direct impacts of project facility construction would occur on the Medicine Lake RMA or other developed recreation use areas on the Forest.

Operation: Operation of the proposed project would not directly prevent the use of any existing facilities within the Medicine Lake RMA or other developed recreation use areas. If closed during construction, the Medicine Lake Lava Flow Trail would be reopened to hikers once construction of the transmission line along segment A1 is complete.

As an attraction, the proposed project may result in a minor increase in visitor use in the Medicine Lake RMA from visitors interested in the geothermal activities of the area. This increase in use would not have a significant effect on the capacity of campground or day-use areas in the Medicine Lake RMA as this increase is expected to be minor, if it occurs at all. The effect on developed recreational uses during project operation would not be considered significant as it is expected that operation of proposed facilities would not limit recreation use or discourage visitors from coming to the area.

Decommissioning: Similar to construction, decommissioning of the proposed transmission line could result in a temporary trail closure along the Medicine Lake Lava Flow Trail, which would result in a short-term adverse impact. Once decommissioning activities are complete, the trail would be reopened and adverse impacts would be eliminated. This short-term impact would not be considered significant. Project decommissioning would not directly impact any other facilities or trails within the Medicine Lake RMA.

Mitigation Measures

The project would not significantly effect developed recreation use areas, and no mitigation is recommended.

4.11.3 Effects on Medicine Lake Residences

Construction, operation, and decommissioning of the proposed action would not alter the seasonal use of the Medicine Lake cabins by residents or disrupt or divide the physical arrangement of these residences. Therefore, no significant or adverse land use conflicts would occur. Short-term adverse impacts related to disturbance and/or nuisance effects of the proposed action would occur during construction and decommissioning.

Construction: Construction activities associated with the proposed wellfield and power plant area would occur approximately 4 miles northwest of the existing homes located on the southeastern shore of Medicine Lake. Construction activities along segment A1 of the proposed transmission line route would occur approximately 4,200 feet (0.8 miles) north of these homes. Construction activities including site clearing and facility erection in both of these areas would not preclude or otherwise limit the seasonal use of these homes. Construction of these facilities also would not limit or preclude access into the Medicine Lake area or into the area occupied by these homes, nor would they serve to disrupt or divide the physical arrangement of these residences. Construction activities, however, may be considered a nuisance by some residents in this areas. Such nuisances may be attributed to construction noise and dust, and the presence of construction vehicles and equipment on roadways around the Medicine Lake area.

As indicated in Sections 4.13, Air Quality and 4.14, Noise, construction dust and noise would result in short-term significant impacts immediately adjacent to construction activities. Dust could be present and noise would be audible during right-of-way clearance, pole erection, and wire stringing associated with segment A1 as construction passes along the north side of the Medicine Lake area. Right-of-way clearance and facility construction along the portion of segment A1 passing just north of Medicine Lake would last no longer than 3 days, in 2 consecutive years. As described in Sections 4.13, Air Quality and 4.14, Noise, the overall effects of short-term construction dust and noise, with mitigation, would be minimized. In addition, odor from well flow testing and venting activities during construction would not be detectable in the Medicine Lake area, as described in Section 4.13, Air Quality.

Construction activities along segment A1 of the transmission line route, may result in the presence of construction vehicles and heavy equipment on Medicine Lake area roads and vicinity, as indicated in Sections 4.9, Visual Resources and 4.12, Transportation. Such equipment would contribute to the noise and dust effects described above and may be considered a visual intrusion to residences in the area.

Overall, the noise, air quality, and visual effects of the project construction would result in a short-term adverse impact on Medicine Lake area residences, as disturbance and nuisance effects could occur. However, construction would not alter the seasonal use of the Medicine Lake cabins by residents or disrupt or divide the physical arrangement of these residences, and significant effects would therefore not be expected to occur.

Operation: Similar to construction, operation of the proposed wellfield, power plant, and transmission line would not preclude or otherwise limit the use of, or access to, the residences at Medicine Lake, nor would they serve to disrupt or divide the physical arrangement of these residences.

It is unlikely that operation of the proposed project would be considered a nuisance by seasonal residents of the Medicine Lake cabins. As indicated in Sections 4.14, Noise, noise related to plant operation and periodic in-fill well drilling would not exceed the most conservative noise standards identified for rural recreational and open space use. Dust and odor from project operation would not exceed standards and would not be detectable from Medicine Lake residences, as described in Section 4.13, Air Quality.

Operation and maintenance activities along segment A1 of the transmission line route would result in the periodic presence of maintenance vehicles on Medicine Lake area roads, as maintenance would occur twice a year in the spring and fall, as indicated in Sections 4.9, Visual Resources and 4.12, Transportation. Due to the limited and sporadic nature of maintenance, it is unlikely that maintenance equipment or activities would be considered a visual intrusion to residences in the area.

Overall, noise, air quality, and visual effects of project operation would not result in significant or adverse impacts on Medicine Lake area residences, as land use conflicts and disturbance and nuisance effects would not occur. Therefore, operation of the proposed project would not interfere or disrupt the normal, on-going use of these seasonal residences, and significant effects would not be expected to occur.

Decommissioning: Similar to construction and operation, decommissioning of the proposed project would not result in land use conflicts with the residences at Medicine Lake as decommissioning would not preclude or otherwise limit the use of, or access to, the residences at Medicine Lake, nor would they serve to disrupt or divide the physical arrangement of these residences. Decommissioning of segment A1 of the proposed transmission line could result in a short-term adverse impact on Medicine Lake residences related to nuisance effects resulting from noise, dust, and the presence of construction vehicles on Medicine Lake area roads. However, this short-term impact would not be considered significant. Once all facilities and equipment are removed, disturbance and nuisance effects on Medicine Lake residences would be eliminated.

Mitigation Measures

Although not required to reduce a significant impact, implementation of Mitigation Measures 4.11.1a through 4.11.1h and 4.14.2c would serve to minimize the adverse impacts on the overall recreation experience.

Level of Significance After Mitigation

Less than significant.

4.11.4 Effect on Dispersed Recreation

Construction, operation, and decommissioning of the proposed project would potentially result in changes in snowmobile use patterns and beneficial impacts related to increased recreational access in areas cleared of vegetation. Once decommissioning of

the proposed project is complete, project effects on recreational uses would be eliminated.

Construction: Effects to dispersed recreation in the wellfield and power plant area would primarily occur during the winter. During the summer, some dispersed recreation may occur at the plant site, but this use is expected to be limited. Potential effects to dispersed recreation uses at the wellfield and power plant area would be the same as described under Impact 4.11.1.

During construction, winter access into the wellfield and power plant area would be provided from the north via Primary Forest Route 15 and Forest Roads 44N01 and 44N64, as described in Chapter 2. At the southern end of Forest Road 44N64, access to the power plant would follow a path of new and existing roads to be improved. This route would roughly parallel the cold injection pipeline, and would cross Forest Road 44N54, which is a snowmobile route.

The plowing of Forest Road 44N01 to provide construction access during the winter may alter snowmobile use patterns. The plowing of this road may encourage some snowmobilers to by-pass the Fourcorners-Medicine Lake Snowmobile Park and drive up to the intersection of Forest Road 44N01 and 44N64, where a gate would be located to provide controlled vehicle access into the wellfield and power plant site. Snowmobilers would park their vehicles and access snowmobile routes from this location, creating an informal staging area.

This informal staging location and associated change in snowmobile use patterns may result in both beneficial and adverse impacts. The informal staging area would have a beneficial effect for snowmobilers by providing an alternate staging area in the springtime at a slightly higher elevation (5,751 feet) than the Fourcorners-Medicine Lake Snowmobile Park (5,309 feet). As the snow levels rise and the Fourcorners-Medicine Lake Snowmobile Park becomes dry, this informal staging area may provide continued snowmobile access, which could enhance late-season snowmobile use in the area. These changes in snowmobile use patterns in this area would not result in a significant impact on snowmobiling in the area.

Use of Forest Road 44N01 for informal and unmanaged snowmobile staging may result in the potential for public safety hazards (particularly during winter storm periods) due to lack of services and shelter that are typically available at established staging areas. This lack of phone services and shelter may put users at risk, as they would not be able to call for assistance and would not have a warm refuge to retreat to during storms. However, Fourcorners-Medicine Lake Snowmobile Park (which provides shelter, but no telephone) is in relatively close proximity, and winter users could use the facilities. In addition, the safety risk at the intersection of Forest Road 44N01 and 44N64 would be no different than the safety risk faced at other dispersed locations on the forests. Snowmobilers who use the area are aware of the remoteness of the area, and would most likely be prepared for emergency situations. The potential safety risk to snowmobilers would therefore not be considered a significant impact.

The plowing of Forest Road 44N01 would preclude the use of this road as a snowmobile trail, which would be an adverse effect. In addition, plowing of the power plant access route would create an interruption in the snowmobile trail along Forest Road 44N54 at

the intersection of this road and the access road as snowmobiles would not be able to cross the plowed intersection. The proposed cold injection line that would cross Forest Road 44N54 at this location would be placed underground and would therefore not interrupt this route. The interruption of this snowmobile trail by the access road would therefore be an adverse impact that can be mitigated. The loss of the snowmobile trail along Forest Road 44N01 and the interruption of the trail along Forest Road 44N54 would not have a significant effect on winter recreation in the project area due to the availability of several other snowmobile trails within the Siskiyou Winter Trails Area. In addition, regional access to and between major destination points (such as Medicine Lake) would not be blocked or interrupted by project activities. Mitigation is identified for interruption of snowmobile use along Forest Road 44N654.

Along the proposed transmission line route, the project would have a combination of adverse and beneficial effects on dispersed recreation. Adverse effects on the recreational experience for dispersed recreationalists would be the same as described under Impact 4.11.1. These effects would occur throughout the dispersed recreation areas in the project vicinity, including released roadless areas. As discussed in Section 4.10. Plans and Policies, segment A2 would cross the Mount Hoffman roadless area. Although the presence of the transmission line in this area could represent a greater contrast with the surrounding forested landscape than in other dispersed recreation areas locations on the forest, the presence of the transmission line in this area would not represent a significant adverse effect. The transmission line would occupy a relatively small proportion of the released roadless area, and construction activities for the line in this area would occur on a temporary basis.

Beneficial recreational effects of project construction would occur as a result of right-of-way vegetation clearance along the transmission line route and along transmission line access roads. The portions of these routes that would be accessible to recreationalists and would benefit both summer and winter dispersed recreation by providing new snowmobile, mountain biking, hiking, and off-road vehicle touring routes. In particular, clearance of a path along transmission line segment A1 could enhance mountain bicycle recreation between Primary Forest Route 77 and Primary Forest Route 49 near Arnica Sink.

Operation: Project operation would have similar impacts on dispersed recreation as those identified above for construction.

Decommissioning: During the dismantling and decommissioning of project facilities similar impacts on dispersed recreation would occur as those identified above for construction. However, once complete, project decommissioning would eliminate the adverse effects of project construction and operation by removing all facilities and eliminating winter access road plowing. The beneficial effects of increased recreational access along the proposed transmission line right-of-way and associated access roads during the winter and summer seasons, would also be eliminated with decommissioning and replanting.

Mitigation Measures

Although not required to reduce a significant impact, implementation of the following mitigation measures would reduce potential adverse effects on dispersed recreational activities:

4.11.4a Calpine shall sign the intersection of the access road to the plant site with Forest Road 44N54 and feather this crossing for snowmobiles. (C)

Level of Significance After Mitigation

Less than significant.

4.11.5 Consistency with ROS Allocations

Construction, operation, and decommission of the proposed action would be consistent with USFS ROS allocations in the project vicinity.

Construction: Project construction would occur entirely in areas with ROS allocations of Roaded Natural, which allows for roads and evidence of human activities. Transmission line segment A2 would head northeast from the Medicine Lake vicinity, and would pass through the Mount Hoffman released roadless area between Mount Hoffman and the Glass Mountain Geologic Area (see Figure 2.2-2). The Mount Hoffman released roadless area is divided into three ROS designations:

- The western flank of Mount Hoffman is allocated as Semi-Primitive Non-motorized
- The eastern flank of Mount Hoffman (the area between Mount Hoffman and the Glass Mountain Geologic Area) is allocated as Roaded Natural
- The Glass Mountain Geologic Area is allocated as Primitive

Segment A2 would pass through the portion of the Mount Hoffman released roadless area that has a ROS designation of Roaded Natural. Segment A2 of the proposed transmission line would skirt the northwest margin of the Glass Mountain Geologic Area which has an ROS designation of Primitive. Approximately 2 miles east of Mt. Hoffman, the transmission line would pass through a gap in the Geologic Area. At this location, a spur of lava extends to the northwest, and is separated from a small outlying patch of lava by several hundred feet. The Glass Mountain Geologic Area includes both the spur of lava and the outlying patch, but does not include the space between the two (see Figure 3.2-2). The proposed transmission line would pass through this gap, which has an ROS designation of Roaded Natural. Construction of the transmission line in this area therefore would be consistent with the ROS designation of Roaded Natural, which allows for road construction and conventional motorized uses.

Construction of the transmission line along the portion of segment A2 within the Mount Hoffman roadless area would result in approximately 2 miles of transmission line and associated access roads within this area. Construction of approximately 7.5 support structures per mile and vegetation clearance along the right-of-way would result in approximately 24 acres of surface disturbance along this 2-mile corridor. Construction of the transmission line through this released roadless area would result in the disturbance of approximately 0.2 percent of the total acreage of this area (11,300 acres).

Access roads along segment A2 would be constructed within the cleared areas directly underneath the conductors. These new access roads would facilitate motor vehicle travel in and through this released roadless area as new access roads could provide a through north-south access route through the area, which currently does not exist. Other roads in the released roadless area are spur roads that provide access to existing geothermal well sites or mining operations. Although this would change the nature of the area as it currently exists, it would not be inconsistent with the ROS designation that allows for road construction and access in this portion of the released roadless area. The ROS designations within this released roadless area contemplate both areas where road access would be allowed and areas where such access would not be allowed. In the eastern portion of the released roadless area a ROS designation of Primitive would not allow for motorized uses. Likewise, in the western portion of this area, a ROS designation of Semi-Primitive Non-Motorized would also not allow for motorized use. The allowed intensity of use contemplated for this area by the USFS would not be altered by construction of the proposed transmission line along segment A2.

Operation: The consistency of project operation with ROS allocations would be the same as those identified above for construction.

Decommissioning: The consistency of project operation with ROS allocations would be the same as those identified above for construction.

Mitigation Measures

Proposed project facilities would be consistent with the ROS allocation for the Glass Mountain Geologic Area, and Mitigation Measure 4.2.2a would ensure that no project activities would take place within this geologic area.

Level of Significance After Mitigation

Less than significant.

4.11.6 Effect on Recreation at the Lava Beds National Monument

Construction, operation, and decommissioning of the proposed action would not directly impact any recreational facilities at the Lava Beds National Monument.

Construction: Since construction of the proposed action would not occur in proximity of the Lava Beds National Monument, no direct effects to recreation at this location would be expected to occur. In addition, views of the project construction from vantage points at the Lava Beds National Monument would not be expected to be significant (see Section 4.9, Visual Resources), and would therefore not significantly affect recreation at the Monument. The effect of project construction on visibility at the Monument is discussed in Section 4.13, Air Quality. These effects would not be expected to significantly affect the recreational experience at the Lava Beds National Monument.

Operation: Operation of the proposed action would not directly prevent the use of any existing facilities at the Lava Beds National Monument. Potential effects on views from the Monument and to visibility are discussed in Section 4.9, Visual Resources and Section 4.13, Air Quality, respectively. As discussed above, these effects would not be

expected to significantly affect the recreational experience at the Lava Beds National Monument.

Decommissioning: As with construction, decommissioning would not directly impact any facilities at the Lava Beds National Monument. Potential effects to the recreational experience at the Monument during decommissioning would be expected to be about the same as for project construction. At the end of the decommissioning phase, it is expected that all project components would be removed, and the project area would be restored to approximate pre-project conditions; this would eliminate the project's effect on views from the Monument and to visibility, as discussed in Section 4.9, Visual Resources and Section 4.13, Air Quality, respectively.

Mitigation Measures

Although not required to reduce a significant impact, Mitigation Measures 4.11.1a through 4.11.1h would minimize the noise, air quality, and visual effects of the project on recreation at the Lava Beds National Monument.

Level of Significance After Mitigation

Less than significant.

4.11.7 Effects on Tionesta Residences

Construction, operation, and decommissioning of the proposed action would not alter the use of Tionesta residences or disrupt or divide the physical arrangement of this community. Therefore, no significant or adverse land use conflicts would occur. Short-term adverse impacts related to disturbance and/or nuisance effects of the proposed action would occur during construction and decommissioning.

Construction: Construction of the proposed wellfield and power plant facilities would occur approximately 20 miles west of the existing homes located in the community of Tionesta. Due to this distance, the construction of the proposed wellfield and power plant would not result in any land use impacts and/or land use conflicts with Tionesta residents.

Construction of the proposed transmission line along segment C1 would pass approximately 1,500 feet north of homes in the Tionesta area, and construction of the transmission line facilities in this area would not preclude or otherwise limit the use of these homes. Construction of the transmission line also would not limit or preclude access into the Tionesta area, nor would it serve to disrupt or divide the physical arrangement of these residences.

Similar to the seasonal Medicine Lake residences, construction activities near Tionesta may be considered a nuisance by some residents in this area. A short-term adverse impact on Tionesta area residences could occur as a result of such disturbance and nuisance effects associated with construction noise and dust and the presence of construction vehicles and equipment on Tionesta area roads (see Section 4.14, Noise).

Operation: As with construction, operation of the proposed wellfield, power plant, and transmission line would not preclude or otherwise limit the use of, or access to, the residences in Tionesta, nor would they serve to disrupt or divide the physical arrangement of these residences.

Similar to the seasonal Medicine Lake residences, it is unlikely that operation of the proposed action would be considered a nuisance by residents in the Tionesta area. The presence of maintenance vehicles on Tionesta area roads, expected to occur twice annually, would be the only source of project noise and dust in the vicinity. Due to the limited and sporadic nature of maintenance, project operation would not result in significant or adverse land use impacts on Tionesta area residences, as land use conflicts and disturbance and nuisance effects would not occur.

Decommissioning: Similar to construction and operation, decommissioning of the proposed action would not result in land use conflicts as such operation would not preclude or otherwise limit the use of, or access to, the residences at Tionesta, nor would they serve to disrupt or divide the physical arrangement of these residences. As with construction, decommissioning of the proposed transmission line could result in a short-term adverse impact on Tionesta residents related to nuisance effects resulting from noise, dust, and the presence of construction vehicles on Tionesta area roads. Once all facilities and equipment are removed, short-term disturbance and nuisance effects on Tionesta residences would be eliminated.

Mitigation Measures

Although not required to reduce a significant impact, Mitigation Measures 4.11.1a through 4.11.1f and 4.14.3a would minimize the noise, air quality, and visual effects of the project on residential uses in the Tionesta area.

Level of Significance After Mitigation

Less than significant.

4.11.8 Effects on Range Lands

Construction, operation, and decommissioning of the proposed wellfield, power plant, and transmission line would not result in significant or adverse impacts effects on designated range lands or grazing activities, and would not affect any prime farmlands.

Construction: Construction of the proposed wellfield and power plant would not result in the removal of any range lands or prime farmlands, as there are no such lands on or in the vicinity of this site. Construction of transmission line segments A1, A2, and B1 would also not affect range lands or prime farmlands. Construction of the proposed transmission line along segment C1 would not affect prime farmlands or result in a substantial loss of grazing land in the Potter's Allotment.

The loss of scrub vegetation within the transmission line right-of-way along segment C1 would be minimal. The only long-term surface disturbance that would occur would be at transmission line support structure sites and access roads. About 14.5 acres would be removed from potential use as grazing land along segment C1 by the development of the support structures (see Chapter 2 for more information on surface disturbance along segment C1). Access roads would occupy approximately 9.6 acres. These roads would be created with minimal vegetation loss using only "wheel tracking," which would involve driving over vegetation to create two parallel wheel tracks (G.E. Raleigh 1996). No blading or grading to create road surfaces would be conducted for these access roads. The reduction in the supply of range land available for grazing in this area by about 25 acres as a result of transmission line and access road construction would be

considered minor. This reduction would not significantly impact the overall availability of land for grazing in the Potter's Allotment.

Cattle in this area may need to be temporarily relocated or shifted from one location to another during transmission line construction (Reed 1996, pers. com.). Once construction activities are completed, cattle may again move into the vicinity of the transmission line facilities. As transmission line construction would not result in a substantial alteration of grazing uses in this area, it would not be considered a significant or adverse impact.

Operation: As with construction, operation of the proposed wellfield and power plant and transmission line segments A1, A2, and B1 would not result in the disturbance of any range lands or prime farmlands, as there are no such lands on or in the vicinity of these facilities. Operation and maintenance of the proposed transmission line along segment C1 would not affect prime farmlands, range lands, or grazing activities in the Potter's Allotment. The presence of the transmission line facilities would not impact grazing activities as the facilities would not prohibit cattle from roaming freely throughout the area. Therefore, the proposed action would not result in a significant or adverse impact on range lands or grazing activities.

Decommissioning: Similar to construction, decommissioning of the proposed wellfield and power plant and transmission line segments A1, A2, and B1 would not result in the disturbance of any range lands or prime farmlands, as there are no such lands on or in the vicinity of these facilities. Decommission of segment C1 would have similar effects as identified above for the construction phase of the project in that cattle would probably need to be temporarily relocated or shifted from one location to another during decommissioning activities. As transmission line decommissioning would not result in a substantial alteration of grazing uses in this area, it would not be considered a significant or adverse impact. Once the pole foundations transmission line access roads are removed, revegetation of these previously cleared areas would return the transmission line right-of-way to pre-project conditions, which would re-open these areas to grazing.

Mitigation Measures

Although no significant or adverse impacts would occur to prime farmlands, range lands, or grazing activities, the following mitigation measure is recommended to minimize adverse effects.

4.11.8a Calpine shall install temporary cattle guards leading from the transmission line to US 139 when constructing the transmission line between Tionesta and the proposed substation. (C)

4.11.9 Effects on Timber Lands

Construction of the proposed wellfield, power plant, and transmission line would remove timber from designated timber lands being managed for both future commercial timber harvesting and resource protection, which is considered an adverse but not significant impact. Operation of the proposed action would also result in adverse impacts to timber lands as on-going maintenance activities would prevent natural revegetation of cleared areas over the life of the project. Decommissioning would return the project sites to forest uses.

Construction: Construction of the proposed wellfield and power plant facilities would result in the removal of approximately 21 acres of timber. It is estimated that approximately 175,000 board feet of timber would be removed during the initial stages of wellfield and power plant construction, as a result of site clearing activities (Stout 1997). While these lands are managed for future timber harvesting, no scheduled timber harvesting would be impacted by this removal of timber.

Construction of the proposed transmission line would result in the removal of approximately 2.1 million board feet of timber on lands being managed for future timber harvesting (Reed 1996, pers. com.; Stout 1996, pers. com.). This removal would occur during the first year of construction as a result of right-of-way clearing along the transmission line route, mostly along segments A1 and A2. Timber removed during this period which is merchantable would be sent to a lumber mill and the USFS would be compensated for this timber at market value. Timber which is not merchantable would be disposed of by burial, chipping, or lopping and scattering (G.E. Raleigh 1996) and would be conducted in accordance with USFS policies.

Relative to the overall supply of timber lands on the Klamath and Modoc National Forests, this reduction in the supply of land available for future timber harvesting and resource protection would be considered an adverse but not significant impact.

Operation: Operation and maintenance of the proposed wellfield, power plant, and transmission line would not impact any additional timber lands over those described above, under construction. However, maintenance activities that would occur during operation, including tree trimming and maintenance of cleared areas under the transmission line conductors, would prevent natural revegetation of cleared areas from occurring over the life of the project. Although the maintenance of areas as cleared areas would be considered an adverse impact to timber lands, this effect would not be considered significant due to the limited scope of maintenance that would be required during operation of the proposed action.

Decommissioning: Decommissioning activities in the wellfield and power plant area and along the transmission line would result in the revegetation of previously cleared areas, which may ultimately return these areas to forested lands. This effect would not be considered adverse or significant.

Mitigation Measures

Although not required to reduce a significant impact, the following mitigation measure would ensure that forest areas disturbed by the proposed action are revegetated as timber lands:

4.11.9a In consultation with the USFS, Calpine shall select and plant appropriate timber species as part of revegetation efforts during decommissioning of the project. Ultimately, this replanting program would serve to replace timber lands removed as a result of project development. (D)

Level of Significance After Mitigation

Less then significant.

4.11.10 Effect on Mining and Geothermal Exploration Activities

Construction, operation, and decommissioning of the proposed action would not be expected to significantly affect any mining or geothermal exploration activities in the vicinity.

Construction: No mining or geothermal exploration activities would be affected by the proposed action during the construction phase. Mining activities at the existing pumice and block pumice mines on the northern flanks of the Medicine Lake Highlands and other locations would not be affected by the proposed action since the proposed transmission line would not be located in the immediate vicinity of these activities. Construction of the proposed action would also not interfere with any geothermal exploration activities that could occur in the area. Due to the limited area that would actually be occupied by the proposed action, it is not expected that the proposed action would interfere with any future mining or geothermal exploration activities. The proposed action would also not affect the utilization of existing geothermal leases in the area. Section 4.2, Geology and Soils provides an evaluation of project effects on mineral resources and Section 4.4, Geothermal Resources provides an evaluation of project effects on geothermal resources.

Operation: The potential for effects to mining or geothermal exploration activities during the operation phase would be the same as during the construction phase.

Decommissioning: The potential for effects to mining or geothermal exploration activities during project decommissioning would be the same as during the construction phase.

Mitigation Measures

No mitigation measures would be required for project effects on mining and geothermal exploration activities as no significant or adverse impacts would occur.

4.11.11 Effect on Mushroom Harvesting

Construction, operation, and decommissioning of the proposed project would not significantly affect mushroom harvesting in the project area.

Construction: Construction of the proposed project would result in the loss and disturbance of some Matsutake mushroom habitat. The mushrooms have been observed to decline with soil disturbance that severs the roots of host trees or disturbs the mycelium layers where mushroom fruiting bodies are produced. Due to previous disturbance at the well pad and power plant sites, construction of the power plant and well pads would have a minimal impact on mushrooms and their habitat. Removal of larger diameter host trees along the transmission line corridor and access roads could affect the regeneration of small populations of the mushroom. The proposed project area would disturb a very small portion of the suitable mushroom habitat available in the project, and thus would have a minimal impact on the amount of mushrooms available for commercial harvesting. For this reason, construction of the transmission line and access would have an adverse, but not significant effect on mushroom harvesting.

During this phase, construction-related dust, odor, and noise could have a temporary adverse effect on mushroom harvesting. Effects on mushroom harvesters would be similar to those described in section 4.11.1 for dispersed recreationalists. These impacts would not limit or discourage mushroom harvesting in the project area, and therefore the impacts would be adverse, but not significant.

Operation: During the operation phase, mushroom habitat along the transmission line corridor and access roads would continue to be disturbed. However, there would not be an additional loss of mushroom habitat during this phase of the project. For the reasons described above, the loss of mushroom habitat would have an adverse, but not significant effect on mushroom harvesting.

During the operation phase, project-related odor and noise could have an adverse effect on mushroom harvesting in the vicinity of the wellfield and power plant. Similar to the construction phase, these effects would not limit or discourage mushroom harvesting in the power plant and wellfield area, and therefore the impacts would adverse, but not significant.

Decommissioning: Decommissioning of the proposed project could result in the restoration of some mushroom habitat lost during the construction phase. Similar to the construction phase, decommissioning activities would result in temporary increases in dust and noise in the project area. These increases would have an adverse, but not significant effect on mushroom harvesting.

Mitigation Measures

The effects of the proposed project on mushroom harvesting would not be significant, and no mitigation measures are recommended.

ALTERNATIVES

As discussed at the beginning of this chapter, the following describes potential effects and recommended mitigation measures for each alternative to the proposed action. Alternatives to the proposed action include various alternate transmission line routes (Alternatives 2 through 6) and the No Action alternative (Alternative 7).

For Alternatives 2 through 6, potential impacts associated with the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of potential impacts along these portions of the transmission line are not repeated under each alternative discussion. The analysis of these impacts focuses on the effects that would be different from those identified for the proposed action and references are provided for those segments that have been previously discussed under the proposed action or a preceding alternative discussion.

Alternative 2 (Segments A1, A2, B1, and C2)

Land use and recreation impacts of the wellfield and power plant, under this alternative, are the same as described above for the proposed action (Alternative 1), as the wellfield and power plant site would occur on the same site as identified for the proposed action.

This alternative would have similar land use and recreation impacts as the proposed action, related to segments A1, A2, and B1. The impact on range lands and grazing activities within the Lava's Allotment along segment C2, would be similar to that described above for the proposed action (segment C1), related to grazing on the Potter's Allotment.

The transmission line under this alternative (segment C2) would pass through the Dobie Flat and Lavas released roadless areas (see Section 4.10, Plans and Policies for more information on these released roadless areas). These areas have ROS allocations of Roaded Natural, which allows for roads, motorized uses and evidence of human presence as would occur under this alternative. Construction of the transmission line through these areas therefore would be consistent with this ROS designation.

Construction of the portion of segment C2 within the Dobie Flat and Lavas released roadless areas would result in approximately 1.5 miles of transmission line within the Lavas area and 1 mile within the Dobie Flat area, as well as associated access roads. Construction of approximately 7.5 support structures per mile and vegetation clearance along the right-of-way would result in approximately 30 acres of surface disturbance along this 2.5-mile corridor. Construction of the transmission line through these released roadless areas would result in the disturbance of approximately 0.08 percent of the total acreage of these areas (38,300 acres).

Access roads along segment C2 would be constructed within the cleared areas directly underneath the conductors and as spur road connections from existing roads in the area. These new access roads may somewhat increase motor vehicle travel in this area, however, there are many other existing roads that provide access into and through these released roadless areas. New access roads along segment C2 therefore would not change the nature of these areas as they currently exists. New road construction would also be consistent with the ROS designation that allows for road construction and access in these released roadless areas. The allowed intensity of use contemplated for these released roadless areas by the Forest Service would not be altered by construction of the transmission line along segment C2.

Similar to the proposed action, this alternative would not disrupt or divide land uses at Tionesta.

Alternative 3 (Segments A1, B2, and C1)

Land use and recreation impacts of the wellfield and power plant, under this alternative, are the same as described above for the proposed action (Alternative 1), as the wellfield and power plant site would occur on the same site as identified for the proposed action.

This alternative would have similar land use and recreation impacts as the proposed action, related to segments A1 and C1. The use of segment B2 under this alternative would eliminate construction of the transmission line (segment A2) through the Mt. Hoffman released roadless area.

The overall acreage of timber removed along B2 would be similar to B1. However, the value of the timber along segment B2 is considered greater as late successional seral

forests exist along portions of this segment. As with the proposed action, the removal of timber along this segment would be considered an adverse impact of the project.

Alternative 4 (Segments A1, B2, and C2)

Land use and recreation impacts of the wellfield and power plant, under this alternative, are the same as described above for the proposed action (Alternative 1), as the wellfield and power plant site would occur on the same site as identified for the proposed action.

This alternative would have similar impacts as the proposed action, related to segment A1. Land use impacts related to the use of segment B2 would be similar to those described above for Alternative 3. Land use impacts related to the use of segment C2 would be similar to those described above for Alternative 2.

Alternative 5 (Segments A3, B1, and C1)

Land use and recreation impacts of the wellfield and power plant, under this alternative, are the same as described above for the proposed action (Alternative 1), as the wellfield and power plant site would occur on the same site as identified for the proposed action.

Land use impacts related to the use of segments B1 and C1 would be similar to those described above for the proposed action. This alternative would avoid the adverse recreational effects at the Medicine Lake Recreation Area associated with segment A1. Alternative 5 would also eliminate construction of the transmission line (segment A2) through the Mt. Hoffman released roadless area.

The effect of this alternative on recreation at the Lava Beds National Monument would be similar to the proposed action, as no recreational areas at the Monument would be directly affected, and views of the proposed transmission line under both the proposed action and this alternative would be limited (see Section 4.9, Visual Resources).

Alternative 6 (Segments A3, B1, and C2)

Land use and recreation impacts of the wellfield and power plant, under this alternative, are the same as described above for the proposed action (Alternative 1), as the wellfield and power plant site would occur on the same site as identified for the proposed action.

Land use impacts related to the use of segment B1 would be similar to those described above for the proposed action. Land use impacts related to the use of segment C2 would be similar to those described above for Alternative 2. Similar to Alternative 5, this alternative would avoid the adverse recreational effects at the Medicine Lake Recreation Area associated with segment A1. This alternative would also eliminate construction of the transmission line (segment A2) through the Mt. Hoffman released roadless area.

The effect of this alternative on recreation at the Lava Beds National Monument would be similar to the proposed action, as no recreational areas at the Monument would be directly affected, and views of the proposed transmission line under both the proposed action and this alternative would be limited (see Section 4.9, Visual Resources).

Alternative 7 (No Action)

Under this alternative, the proposed action would not be implemented, and no effects to land use or recreation in the project vicinity would occur.

4.12 Transportation

KEY ISSUES

No key issues were identified for transportation.

SIGNIFICANCE CRITERIA

In accordance with the CEQA Guidelines, a project would be considered to have a significant effect on the environment if it would cause an increase in traffic that is substantial in relation to the existing volumes and capacity of the road network. A project may also have a significant effect on the environment if project traffic or access would conflict with established land uses in the area, such as recreational uses, or would pose public health and safety hazards.

In addition, the USFS considers destruction of existing roadways in the Klamath and Modoc National Forests by heavy truck use to be a significant adverse effect (Sharp in BLM et. al. 1995).

METHODOLOGY

The transportation analysis in this section is based on current operating conditions of project area roadways, as well as anticipated traffic volumes generated by the proposed project. Anticipated project traffic volumes are based on estimates of maximum daily vehicle trips that would occur during construction, operation, and decommissioning of the proposed project (Alternative 1) or the other alternatives. This information was developed by Calpine based on construction phasing and project operation information provided in Chapter 2, and was evaluated for this analysis.

Calpine has also consulted with USFS and Lava Beds National Monument staff regarding potential access routes to the power plant and wellfield area and the transmission line route. Based on consultations with the USFS, it was agreed that winter access and heavy construction equipment access would occur from the northwest. The consultations with Lava Beds National Monument staff resulted in an agreement that construction vehicles would not pass through the Monument to access the project area. These measures have been incorporated into the proposed action.

PROPOSED ACTION (ALTERNATIVE 1)

4.12.1 Effects on Road Traffic

Construction, operation, and decommissioning of the proposed project would result in additional daily trips on project area roads. During the construction and decommissioning phases, the increased number of trips would have a significant effect on traffic conditions along Forest Roads 44N01 and 44N64. Other project area roads would not be significantly affected by estimated traffic increases.

Construction: Construction of the proposed wellfield, power plant, and transmission line would result in a temporary increase in vehicular traffic in the vicinity of the project area. This increase would be the greatest during the second summer season after project commencement when wellfield and power plant construction, well drilling, and transmission line construction would occur concurrently.

The construction phase of the proposed project would result in a maximum of 228 trips per day during the summer. The increase in average daily trips would be related to construction workers traveling to and from the area, and construction vehicles delivering and/or hauling materials (such as water trucks). Construction vehicles are expected to generate an additional 68 truck trips per day related to the following construction activities:

- Delivery of drill rig equipment
- Carrying log hauls during site clearance
- Removal of graded material
- Delivery and re-supply of water trucks for dust control
- Delivery of major equipment

Most of the materials that would be hauled on project area roads would be typical of new construction and would come to the site on standard semi-truck loads. Exceptions to this would include major equipment such as turbines, generators, condensers, the main transformer, and transmission line poles, which would require special over-size and over-weight permits and flag cars.

During the summer season, construction workers would be expected to generate a maximum of 160 trips per day. This number is based on the maximum temporary construction work force that would be expected to occur between May and November in the second year of construction when concurrent wellfield and power plant construction, well drilling, and transmission line construction would occur. It is anticipated that crew buses would be used to pick up construction employees from various surrounding locations; therefore, it is unlikely that the maximum of 160 trips per day would actually occur on roads in the immediate vicinity of the project.

During the winter, construction activities would focus primarily on interior work related to the construction of the turbine pedestal and other equipment foundations within the shelter of the turbine building. It is expected that all exterior construction work related to the wellfield, power plant, and transmission line would cease between October and May. However, well drilling activities may continue as late as the end of each calendar year.

As a result of scaled back construction activities during the winter, it is expected that construction-related vehicular traffic in the vicinity of the project area, would be less than what would occur during the summer. Winter construction would result in a maximum increase of approximately 75 trips per day from construction employees traveling to and from the wellfield and power plant site. Construction vehicles are not expected to generate more than several additional truck trips per day during the winter as minimal equipment deliveries and hauling would occur.

During the summer, construction employee and vehicle access would be primarily from the northwest via Primary Forest Route 15 or 77 to Forest Road 44N01 to Forest Road 44N64, as described above. This access route would be the only route used during the winter (see section 4.12.3 below). The majority of new trips would occur along these roadways. Primary Forest Routes 15 and 77 are designed to adequately accommodate the estimated increased traffic volumes. Given the current capacities and low use of

these two roads, the additional trips generated by construction of the proposed action would not be expected to adversely affect traffic volumes or traffic conditions along these roads. Therefore, increased trips along Forest Routes 15 and 77 would not have a significant impact on traffic volumes or conditions.

Forest Roads 44N01 and 44N64 have current traffic volumes of 10 to 20 trips per day and were not designed to accommodate traffic volumes of over 200 trips per day as estimated for the summer months of the construction phase. The estimated increase in daily trips during the summer would exceed the traffic capacity that could be safely accommodated on these two roads. Therefore, the additional daily trips generated during the construction phase would have a significant effect on traffic conditions on Forest Roads 44N01 and 44N64. During the winter, it is proposed that employees would park near the Fourcorners-Medicine Lake Snowmobile Park and carpool to the site via four-wheel drive vehicles, which would minimize trips on 44N01 and 44N64.

Operation: Operation and maintenance of the proposed wellfield, power plant, and transmission line would result in a slight increase in vehicular traffic in the vicinity of the project area. A maximum of approximately 19 daily trips would result from new employees traveling to and from the wellfield and power plant area during operational infill well drilling activities. During operation, when no infill well drilling is occurring, only 3 daily vehicle trips would be generated by employees. Occasional maintenance vehicles would travel out and along the transmission line to perform routine maintenance activities. During such activities, 1 to 2 additional trips on transmission line access roads and project area forest roads would be expected to occur. Truck and vehicle trips associated with transmission line maintenance activities would not occur during the winter months.

The additional daily trips generated during project operation would not significantly effect traffic conditions or volumes along the main access route into the wellfield and power plant area or on other project area roads. Therefore, this increase in traffic would be a less-than-significant impact.

Decommissioning: Decommissioning of the proposed wellfield, power plant, and transmission line facilities would result in similar daily trips and traffic effects as would occur during the construction phase of the proposed action. As described for the construction phase, the additional number of daily trips generated by project decommissioning would result in traffic volumes that could not be safely accommodated on Forest Roads 44N01 and 44N64. The increased traffic volumes on these roads would be a significant impact.

Mitigation Measures

The following mitigation measure is recommended to reduce the impacts of increased traffic volumes on Forest Roads 44N01 and 44N64.

4.12.1a Calpine, under the direction of the USFS, shall make improvements to Forest Roads 44N01 and 44N64 to ensure that projected traffic volumes can be safely accommodated on these roads. (C)

Level of Significance After Mitigation

Less than significant.

4.12.2 Effect on Structural Integrity of Project Area Roads

Estimated traffic volumes during the construction and decommissioning phases of the proposed project would have a significant effect on the structural integrity of Primary Forest Route 15, and Forest Roads 44N01 and 44N64. During the operation phase of the project, increased traffic volumes would not significantly affect project area roads.

Construction: As described above, the proposed project would generate a maximum of 228 daily trips along the primary access route (Primary Forest Routes 15 and 77 to Forest Roads 44N01 and 44N64) during the summer months of the construction phase. USFS engineers estimate that the project generated traffic volumes would destroy the existing structural integrity of Forest Roads 44N01 and 44N64 and would seriously impair the structural integrity of Forest Route 15 (Solus 1997). These impacts would be significant.

Operation: During the operation phase, a maximum of approximately 19 new daily trips would be generated by the proposed project. This number of new trips would not be expected to significantly affect the structural integrity of any project area roads.

Decommissioning: Decommissioning of the proposed wellfield, power plant, and transmission line facilities would result in similar daily trips and traffic effects as would occur during the construction phase of the proposed action. As described under the construction phase, USFS engineers estimate that this increase in traffic volumes would have a significant impact on the structural integrity of Primary Forest Route 15 and Forest Roads 44N01 and 44N64.

Mitigation Measures

4.12.2a The USFS shall develop a road maintenance plan for project area roads to ensure that the structural integrity of these roads is not impaired by the proposed project. Calpine shall be responsible for implementing or financing this maintenance plan and make any necessary repairs. (C,O,D)

Level of Significance After Mitigation

Less than significant.

4.12.3 Summer Access Issues

By providing road use limitations (described below) for construction vehicles and equipment during the construction phase, project construction would not be expected to result in adverse effects related to access issues during the summer months. Project operation and maintenance would not result in significant adverse effects related to traffic conflicts during the summer months. Road use limitation during decommissioning of the proposed action would also prevent adverse effects related to access issues from occurring during the summer months.

Construction: As discussed in Section 3.12, a variety of existing routes could be used to access the proposed power plant and wellfield area during the summer months. The two primary available access routes to the power plant and wellfield area are Primary Forest Route 97 to Primary Forest Route 49 (which approaches the wellfield from the east), and Primary Forest Route 15 or 77 to Forest Road 44N01 to Forest Road 44N64 (which approaches the wellfield from the west). Primary Forest Route 49 can also be

used to access the power plant and wellfield area from the north, through the Lava Beds National Monument (see Figure 2.2-2).

Based on agreements with the USFS and Lava Beds National Monument, Calpine would limit access for construction vehicles needed to construct the power plant and wellfield to the approach from the northwest (i.e., Primary Forest Route 15 or 77 to Forest Road 44N01 to Forest Road 44N64 to the wellfield). The access limitation would also prevent heavy construction vehicles from using Forest Road 43N48 along the north shore of Medicine Lake. This access restriction would minimize potential conflicts in the summer months between project construction and hauling vehicles and recreational uses at the Medicine Lake Recreation Management Area and the Lava Beds National Monument.

Construction of segments A1 and A2 may require the use of Medicine Lake area roads by construction vehicles. Use of these roads to access the transmission line corridor could result in conflicts between project-related vehicle access and recreational uses at Medicine Lake. Mitigation measures are identified to reduce these potential for conflicts. Transmission line segments B1 and C1 are readily accessible by existing roads in the area, and there are no established recreation areas near these segments or their access roads. Therefore, access to these segments would not create potential conflicts with recreational uses in these areas.

Operation: During the operation phase, vehicle trips generated by the project would be primarily limited to employee vehicle access into the wellfield and power plant area. Vehicle numbers would be relatively few and heavy truck loads would only occur if major equipment needed to be replaced. Therefore, project-related traffic would not conflict with recreational use areas.

Decommissioning: Decommissioning of the wellfield, power plant, and transmission line would require the use of similar vehicle numbers and vehicle types as identified for the construction phase. As described above, potential conflicts with recreational uses would be primarily related to the decommissioning of transmission line segments A1 and A2 and conflicts with recreational uses at Medicine Lake.

Mitigation Measures

4.12.3a The USFS shall require that Calpine develop and implement a construction and decommissioning access plan that stipulates construction and decommissioning equipment and truck access routes into the proposed transmission line route along segments A1 and A2. This plan shall also be used for any heavy truck hauling required during the operation phase and shall provide for the following:

- Avoidance of Primary Forest Route 49 between Primary Route 97 and 77, in the Medicine Lake area
- Avoidance of Forest Road 43N48
- Consideration of Forest Road 43N53 as access points into segments A1 and A2
- Identification of an access route for through traffic between the wellfield and power plant area, and the transmission line route to ensure avoidance of roads identified above

- Construction and decommissioning equipment and truck traffic originating from Highway 139 east of the Medicine Lake Highlands would follow a path of travel west on Primary Forest Route 97 to its intersection with Forest Road 44N01, then northwest past Cougar Butte to a section of Primary Forest Route 49 (44N75), and then southward to the wellfield and power plant area
- If these roads cannot be avoided, then construction and decommissioning vehicle trips on these roads shall be prohibited from traveling on these roads during weekends and holidays, signage shall be provided in the area warning recreationalists of the presence of construction or decommissioning vehicles, and the applicant shall repair pavement that is damaged and destroyed as a result of construction or decommissioning vehicles. (C, O, D)

Level of Significance After Mitigation
Less than significant.

4.12.4 Winter Access Issues

Construction, operation, and decommissioning traffic related to the proposed project during the winter would not significantly affect access conditions or result in traffic conflicts with recreational activities. Therefore, this would effect would be a less-than-significant impact.

Construction: The project area receives a significant amount of snowfall during the winter months that restricts vehicular access to the area. Project construction during the winter would be reduced, but construction employees would need to have continued winter season access to the wellfield and power plant site.

Based on agreements with the USFS and Lava Beds National Monument, Calpine would allow winter access to the power plant and wellfield only from the north and west (i.e., Primary Forest Route 15 or 77 to Forest Road 44N01 to Forest Road 44N64 to the wellfield). Access to the power plant and wellfield area from the east (Primary Forest Routes 97 and 49) would not be kept open in the Medicine Lake area, and this route would not be used in the winter months to access the wellfield and power plant areas. Access could not be obtained through the Lava Beds National Monument during the winter months because Primary Forest Route 49 would not be kept open in the Medicine Lake Highlands.

In the winter, Primary Forest Route 15 is currently kept open by the USFS to the Fourcorners-Medicine Lake Snowmobile Park (see Figure 2.2-2). The USFS performs snow blowing and removal along this road as necessary during the winter. Along 44N01 and 44N64 from the snowmobile park to the wellfield, Calpine proposes to conduct snow blowing and removal as necessary in order to keep this road open in the winter. In addition, a carpool area would be established near the snowmobile park, and a 4X4 company vehicle would be available to transport employees to and from the wellfield during winter months. A sno-cat would be available to transport employees between the carpool area and the wellfield during snow events and when access is snow-bound.

Construction traffic conflicts with recreationalists in the Lava Beds National Monument and the Medicine Lake area would not occur during the winter due to low existing and project traffic volumes, and reduced recreational activities in these areas. Impacts of winter access routes on snowmobile use patterns are discussed in Section 4.11, Land Use and Recreation.

Operation: Project operation employees would access the wellfield and power plant area via the winter access route identified above for winter construction. Employee vehicle access into the wellfield and power plant area during winter operation would not result in traffic conflicts or access concerns in the Medicine Lake area and the Lava Beds National Monument. Therefore, as no effects on winter recreationalists would occur during operation, this is considered to be a less-than-significant impact.

Decommissioning: It is assumed that decommissioning activities associated with the wellfield, power plant, and transmission line during the winter would be minimal and would likely focus on interior portions of the power plant facility. Therefore, the winter access conditions for decommissioning would be similar to those described above for the construction period, as similar vehicle numbers and vehicle types would be used during decommissioning of the project. Once operation ceases and the facilities and equipment are removed, project traffic would be eliminated.

Mitigation Measures

No mitigation is recommended.

ALTERNATIVES

As discussed at the beginning of this chapter, the following discussion describes potential effects and recommended mitigation measures for each alternative to the proposed action. Alternatives to the proposed action include various alternate transmission line routes (Alternatives 2 through 6) and the No Action alternative (Alternative 7).

For Alternatives 2 through 6, potential impacts associated with the proposed wellfield and power plant would be the same as described for the proposed action since these facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of potential impacts along these portions of the transmission line are not repeated under each alternative discussion. The analysis of these impacts focuses on the effects that would be different from those identified for the proposed action and references are provided for those segments that have been previously discussed under the proposed action or a preceding alternative discussion.

Alternative 2 (Segments A1, A2, B1, and C2)

Under Alternative 2, traffic and road wear impacts would be the same as described for the proposed project, and would be significant. The same summer and winter project access issues would occur also under Alternative 2 as would occur with the proposed action. The mitigation measures identified for the proposed project would also apply to this alternative, and impacts after mitigation would be less than significant.

Alternative 3 (Segments A1, B2, and C1)

Under Alternative 3, traffic and road wear impacts would be the same as described for the proposed project, and would be significant. Alternative 3 would generally have the same summer and winter project access issues as the proposed action. However, by constructing the transmission line along segment B2, this alternative could result in the need for heavy construction equipment to use Primary Forest Route 97 up to the Medicine Lake area for transmission line construction during the summer months. The access required for construction of segment B2 could result in the potential for greater conflicts with access to recreational areas at Medicine Lake than the proposed project, but these impacts would not be significant. Mitigation Measure 4.12.3a would reduce the potential for construction of transmission line segments A1 and B2 under this alternative to conflict with summer access to recreational areas at Medicine Lake. Transportation impacts of this alternative would be less than significant after mitigation.

Alternative 4 (Segments A1, B2, and C2)

Traffic and road wear impacts for Alternative 4 would be the same as described for the proposed project, and would be significant. This alternative would generally have the same summer and winter project access issues as the proposed action. However, similar to Alternative 3, Alternative 4 would develop transmission line along segment B2. Constructing the transmission line along segment B2 could result in the need for heavy construction equipment to use Primary Forest Route 97 up to the Medicine Lake area for transmission line construction during the summer months. The access required for construction of segment B2 could result in the potential for greater conflicts with access to recreational areas at Medicine Lake than the proposed project, but these impacts would not be significant. The mitigation measures identified for the proposed project would also apply to this alternative, and would reduce the impacts to a less-than-significant level.

Alternative 5 (Segments A3, B1, and C1)

Under Alternative 5, traffic and road wear impacts would be the same as described for the proposed project, and would be significant. By not constructing a transmission line in the Medicine Lake area, Alternative 5 would avoid the conflicts with summer access to recreational areas at Medicine Lake that could occur under the proposed action with construction of transmission line segments A1 and A2. Alternative 5 would result in the same winter access issues as described above for the proposed action. Mitigation Measure 4.12.3a would not apply to this alternative because there would be no potential summer access conflicts with recreational uses at Medicine Lake. Mitigation Measures 4.12.1a and 4.12.2a identified for the proposed project would also apply to this alternative. Transportation impacts of this alternative would be less than significant after mitigation.

Alternative 6 (Segments A3, B1, and C2)

Under Alternative 6, traffic and road wear impacts would be the same as described for the proposed project, and would be significant. By not constructing a transmission line in the Medicine Lake area, Alternative 6 would avoid the conflicts with summer access to recreational areas at Medicine Lake that could occur under the proposed action with

construction of transmission line segments A1 and A2. Alternative 6 would result in the same winter access issues and summer and winter traffic volumes and traffic conditions on area roads as described above for the proposed action. Mitigation Measure 4.12.3a would not apply to this alternative because there would be no potential summer access conflicts with recreational uses at Medicine Lake. Mitigation Measures 4.12.1a and 4.12.2a identified for the proposed project would also apply to this alternative. Transportation impacts of this alternative would be less than significant after mitigation.

Alternative 7 (No Action)

Under the No Action alternative, the proposed project would not be constructed, and no use of project area roads would be required for the project. This alternative would therefore not result in access issues or have an effect on traffic volumes or traffic conditions on area roads.

4.13 Air Quality

REGULATORY FRAMEWORK

Federal, state, and local requirements provide for the regulation of air quality in the project vicinity. A discussion of these requirements follows. Please refer to Section 3.13, Chapter 3 for a discussion of Federal and state ambient air quality standards (AAQS). The Federal and state AAQS are provided in Table 3.13-3.

Federal

Under the Federal Clean Air Act (CAA), a proposed major source of criteria pollutants is subject to Prevention of Significant Deterioration (PSD) requirements and permitting (CAA Part C Sections 160-169). A major source is defined in 40 CFR 52.21 as a specified source of air pollution (such as an electric power plant or large industrial facility) that emits or has the potential to emit 100 tons per year or more of any criteria pollutant. For non-specified sources (such as geothermal power plants), the major source designation applies to those that emit or have the potential to emit 250 tons per year or more of any criteria pollutant. The proposed project would not be considered a major source subject to PSD review based upon calculated annual emissions.

State and Local

The Siskiyou County Air Pollution Control District (SCAPCD) is responsible for local regulation of air quality, and for implementing state programs and policies to comply with the California Clean Air Act. New sources of air pollutants must acquire an Authority to Construct (ATC) and a Permit to Operate (PTO) from the SCAPCD. Rules for new sources are identified in Regulation VI of the District's Rules and Regulations (SCAPCD 1989).

In order to regulate new air emission sources that would emit or have the potential to emit criteria air pollutants, SCAPCD has adopted New Source Review (NSR) requirements. Two key provisions of NSR requirements are the use of best available control technology (BACT) and the identification of the need for emission offsets. BACT is required for sources emitting more than 250 pounds per day (lb/day) of any pollutant for which there is a national ambient air quality standard, or any precursor of such a pollutant. Emission offsets (or mitigation) are required for net emission increases (after the application of BACT) of 250 or more pounds per day of any pollutant for which a national ambient air quality standard has been exceeded three or more discontinuous times (for annual standards, one time) within the three years immediately preceding the permit application date. The offset of net emission increases would not be required if it is demonstrated through modeling that emissions from a new source would not cause a new violation of any ambient air quality standard.

KEY ISSUES

The key air quality issues identified and evaluated in this section relate to the construction dust effects in the Medicine Lake area and in Tionesta. These effects are evaluated in Impact 4.13.1. Another key issue relates to the effects of power plant emissions at Medicine Lake. These effects are evaluated in Impacts 4.13.1 through 4.13.8.

SIGNIFICANCE CRITERIA

The CEQA Guidelines provide criteria for determination of impacts that are to be considered significant. Appendix G of the CEQA Guidelines states that a project would normally have a significant effect on the environment if it will:

- Violate any ambient air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations
- Create a potential public health hazard
- Have a substantial, demonstrable negative aesthetic effect

Appendix I of the CEQA Guidelines indicates that a project could have a significant effect on the environment if it results in substantial air emissions or deterioration of ambient air quality, creates objectionable odors, or alters air movement, moisture, temperature, or the local or regional climate. Based on this guidance, specific standards and thresholds for determining impact significance for criteria pollutants, health risks, odor nuisances, and visibility impairment are identified below.

Criteria Pollutants

Air quality impacts are considered significant in this analysis if:

- The estimated concentration of a criteria pollutant at any receptor exceeds its state or Federal ambient air quality standard.
- The estimated concentration, added to measured or reasonably expected background concentrations in the area, exceeds a relevant state or Federal ambient air quality standard.

Public Health Risks

State and Federal ambient air quality standards have not been established for most toxic air pollutants. Health risk assessments are typically used to estimate the significance of these emissions. CARB considers an individual cancer risk probability estimate of one to 100 extra cases of cancer per million people exposed to be an acceptable risk level (CARB 1993); this level would be considered a less-than-significant impact. For non-cancer health effects, CARB requires the calculation of a hazard index (HI). A total hazard index greater than one may indicate that a source has a significant potential to cause adverse noncancer risks. A total HI less than 1 is not considered to be significant (CAPCOA 1993; CARB 1993).

Odor

The state 1-hour H_2S standard of 42 $\mu g/m^3$ is also considered to be an odor nuisance significance threshold. Therefore, any exceedances of the state H_2S standard at identified receptor locations would be considered a significant impact.

Visibility Impairment

The PSD regulations, described above, require that an analysis of visibility impairment be performed for all Class I areas within 100 kilometers (about 62 miles) of a proposed major new source. Class I areas are National Parks and wilderness areas subject to the greatest air impact restrictions. As the proposed project would not be considered a major new source requiring PSD review, an analysis of visibility impairment is not

required. However, as there are two adjacent Class I areas within the sphere of possible impact from the project, a visibility impairment analysis is provided in this section. The Class I areas are located within the two wilderness areas of the Lava Beds National Monument, as described in Section 3.13 of Chapter 3.

There are currently no quantified standards upon which to make a determination of significance for potential visibility effects of a proposed project. Visibility effects can be analyzed qualitatively in terms of the perceptible contrast of a plume from a source against a background (e.g., the sky or the terrain) and the potential contribution of a source to the reduction in visual range of an area (regional haze).

Although no regulatory standards exist for assessing plume perceptibility, assessment guidelines have been established by the EPA for modeling visibility effects. These assessment guidelines for visibility modeling are given as two values that are based on studies of human perceptibility of differences in color (or "ΔE ") and changes in plume contrast. If visibility modeling predicts that the proposed project would result in exceedances of color and contrast criteria within a sensitive airshed, this would be considered a potentially significant effect. The ΔE criterion is 2.00 and the contrast criterion is 0.05. The impact would be considered potentially significant because exceedance of screening criteria does not conclusively determine that a plume would be perceptible. The screening models are not conclusive because the results overestimate the likely plume perceptibility due to the conservative assumptions used in these models. For example, the model may assume conditions that physically cannot occur in a given project area, and the model does not consider complex terrain.

METHODOLOGY

The potential impacts of the proposed project, including the construction of the wellfield, power plant, and transmission line, and operation of the proposed facility were quantitatively assessed by a multi-step process, including:

- Reviewing the proposed project to identify emission sources during the construction phase and the normal and upset operation of the power plant
- Estimating emissions for each of the potential sources identified
- Using the emissions data, along with appropriate meteorological, geographical and engineering data, in dispersion and visibility models and in health risk calculations to define estimated concentrations of emitted substances in the ambient air, the likely health risks, and the potential for plume visibility.
- Comparing the estimated impacts to appropriate significance criteria in order to identify those estimated impacts that would be considered significant

The section below describing the effects of the proposed action provides information on the sources and estimates of project emissions, as well as an evaluation of project effects of such emissions based on the results of dispersion modeling, visibility modeling, and health risk calculations. Appendix F provides additional technical information regarding methodologies and project design assumptions used in developing the emissions estimates and in conducting the modeling.

PROPOSED ACTION (ALTERNATIVE 1)

Introduction

This introduction to the impact evaluation of the proposed project briefly summarizes the primary project emissions and sources, describes the construction and operational scenarios evaluated for the project, identifies the receptor locations evaluated, and provides the organization for the impact analysis.

Overview of Project Emissions: The primary project emissions are geothermal steam and condensate from venting wells, the power plant cooling towers, and the plant vent silencers. The key constituent of concern in these emissions is H_2S, primarily due to the potential for nuisance odor. Emissions from these sources also contain particulate matter and low levels of other constituents, such as boron, ammonia, mercury, manganese, arsenic and volatile organic compounds. Project emissions would also result from:

- Dust generated from construction vehicle traffic and construction of well pads, access roads, the plant site, and transmission line structures
- PM_{10} and criteria pollutants emitted from drill rig diesel generators and the plant back-up generator
- Vehicle emissions

These emission sources would generate primarily criteria pollutants or their precursors, including PM_{10}, NO_x, SO_x, CO, and lead. Table 4.13-1 summarizes the sources of project emissions during each phase of the project, including construction, normal operation, and upset conditions. Each of these phases are defined and described below. Appendix F provides additional detail regarding the scenarios evaluated.

Scenarios Evaluated: The impact evaluations provided below address construction, normal operation, upset operation, and decommissioning conditions. The scenarios evaluated for each of the project phases are briefly summarized below and are described in detail in Appendix F.

Construction: The construction phase of the proposed project would occur over a three-year period with the majority of project construction work occurring during the summer seasons (i.e., from April to October). The following is a breakdown of the construction schedule by year:

- **Year 1:** Construct well pads and associated roads in the wellfield area (outside the Goshawk habitat area) and conduct confirmation well drilling and testing at two pads during the summer months. If drilling confirms available geothermal resource, all remaining well pads and associated access roads will be completed.
- **Year 2:** During the second year, power plant construction will begin and drilling and testing of additional wells will continue. Clearance of transmission line right-of-way and associated access roads would begin. Construction inside plant buildings would continue through winter.
- **Year 3:** During the summer months, complete drilling of production and injection wells in the wellfield, complete clearance of the transmission line right-of-way, install support structures and transmission line, construct substation, and connect transmission line to BPA Malin-Warner line at substation. During the winter, complete construction of the power plant and ensure plant is ready for start-up.

Table 4.13-1: Summary of Project Emission Sources

Project Phase	Non-Criteria Pollutants	H_2S	PM_{10}	CO	NO_x	SO_x	Lead
Construction							
Ground Disturbing Activities*			X				
Vehicles and Equipment*			X	X	X	X	
Drill Rig Generators*			X	X	X	X	
Plant Backup Generator*			X	X	X	X	
Well Flow Testing*	X	X	X	X			X
Normal Operation							
Plant Vent Silencer							
Cooling Tower	X	X	X				X
Drill Rig Engines*	X	X	X				X
Well Flow Testing*			X	X	X	X	
	X	X	X				X
Upset Operation							
Plant Vent Silencer*	X	X	X				
Plant Backup Generator*			X	X	X	X	X
Decommissioning							
Ground Disturbing Activities/Demolition*			X				
Vehicles and Equipment*			X	X	X	X	

Notes:

* Temporary emission sources during construction, and normal and upset operation. The only long-term sources of air pollutants from the project would occur during normal operation as a result of emissions from the plant vent silencers and the cooling tower.

SOURCE: MHA Environmental Consulting, Inc., 1997; Calpine POU, 1996

Normal Operation: The normal operational conditions modeled considered emissions from the cooling tower and the plant vent silencer (low pressure liquid flashing to steam), which are the primary sources of emissions during normal operation. Fugitive dust emissions from traffic during normal operations are considered in the impact analysis. Normal operation conditions modeled also address infill (replacement wells to maintain adequate steam flow) well drilling. Such infill well drilling is expected to occur infrequently, approximately every one to two years.

Upset Conditions: Plant upset conditions can result from:

- Power plant equipment failure
- Transmission line fault or failure
- Switchyard or substation equipment failure

The upset conditions modeled for the maximum potential air quality impacts assume a worst-case upset condition when both turbines are non-operational (called a dual turbine outage upset) and when the turbine bypass system is unavailable. Such a condition would occur most likely as a result of a plant equipment problem resulting in a turbine unit trip. Under such conditions, 100 percent of the steam flow would be directed to the plant vent silencer. (The flash vessels and polishing separators would remain on line, but the steam from each stage would be directed to the plant silencer instead of the turbines). This full-flow case would occur during an upset lasting less than 24 hours, during which Calpine may elect not to reduce steam flow from the wells. When the turbine bypass system is unavailable, H_2S emissions would be abated by a backup abatement system that would inject hydrogen peroxide or a caustic solution into the produced steam at a point prior to the plant silencer. The backup abatement system would provide about 80% H_2S control efficiency (95% control efficiency of H_2S would be achieved under normal operations).

In most cases, the turbine bypass system would be operational and would direct steam flow to the condenser when a turbine is down, which would provide for non-condensable gas treatment. Additionally, depending on the length of the outage, the flow from the wells may be fully vented or it may be gradually reduced using the well flow control valves. Calpine has indicated that they would reduce flow to about two-thirds by throttling back the wells for upsets lasting longer than 24 hours. However, only upset scenarios including venting of the full steam flow through the plant silencers were used in the analyses of maximum potential air quality impacts. Upsets that resulted in shutdown of only one turbine, or in which Calpine reduced flow from the steam field, would have lesser emissions than the full-flow case described above.

Based on operating experience at similar facilities, Calpine estimates that an average of three or four short-duration plant upsets, averaging about six hours duration, will occur in a typical year. Approximately once every two years, Calpine expects that a planned outage (plant shutdown) will occur, typically lasting two or three days. Calpine anticipates that an unplanned, long-term upset (lasting 10 to 15 days) may occur every three to ten years. The expected average number of hours per year for each of these upset conditions were used to determine the contribution of upset emissions to annual average emissions.

Decommissioning: It is assumed that decommissioning would be similar to the construction phase of the project in terms of the numbers and types of vehicles used and the time frame for conducting decommissioning activities. The only construction activities that would not occur during decommissioning would be well drilling and well flow testing.

Receptor Locations: Receptor locations were identified based on review of activity patterns in the project area, the population distribution in the surrounding locations, and proximity to project activity areas. For example, Medicine Lake receptors were selected due to their proximity to the wellfield and power plant site and the transmission line corridor, and due to the high visitor use that the area receives. Tionesta was selected due to its proximity to the transmission line and as it is the closest year-round residential community to the project site. Twenty-two receptor locations were evaluated (See Table 18 of Appendix F). The receptor locations are shown in Figures 4.13-1 and 4.13-2. As project effects at all of the receptor locations are generally minimal, this impact evaluation focuses on the six to eight closest receptor locations, which represent the full range of possible wind directions and the worst-case impacts. Appendix F provides modeling results for all receptor locations studied.

Organization of Impact Analysis: The impact analyses in this section are organized somewhat differently than the other sections contained in Chapter 4. In other sections, impact discussions are organized by relevant impact topics, with evaluations for construction, operation, and decommissioning activities under each topic. In this section, the impact evaluation related to criteria pollutants is broken out by both pollutant and phase. For example, PM_{10} impacts are addressed in separate discussions for construction, operation, and decommission of the project. This is also true for other criteria pollutants. This was done to clarify the evaluation which would have been very lengthy had the organization of other sections been followed. Impact analyses for other topics, however, do follow the format established in other sections. For example, the visibility and public health risk impacts address construction, operation, and decommissioning.

The impact analyses contained in this section are organized by the following categories:

- Effects of criteria pollutants (focuses on PM_{10}, H_2S, and other criteria pollutants)
- Effects on public health (focuses on potential health effects of both criteria and non-criteria pollutants)
- Effects on visibility (focuses on the visibility impacts of NO_x and PM_{10} emissions)
- Effects on global warming
- General Conformity Analysis

4.13.1 Effects of Construction PM_{10} Emissions

Construction of the proposed wellfield, power plant, and transmission line facilities would not result in significant impacts at adjacent receptor locations, as the 24-hour and annual PM_{10} standards would not be exceeded. A significant unavoidable short-term PM_{10} impact could occur in close proximity to construction activities.

Figure 4.13-1: Receptor Locations Used in Modeling

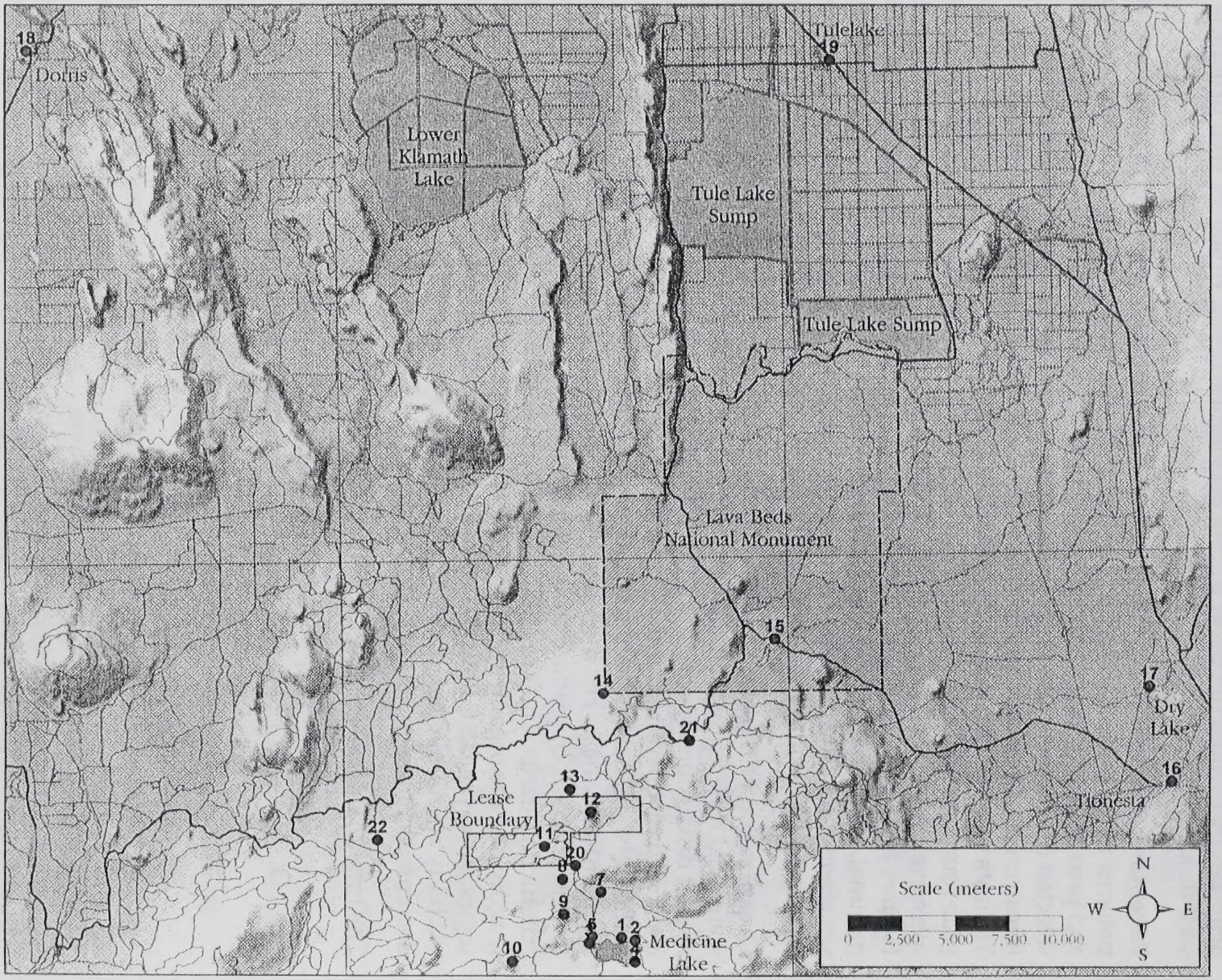
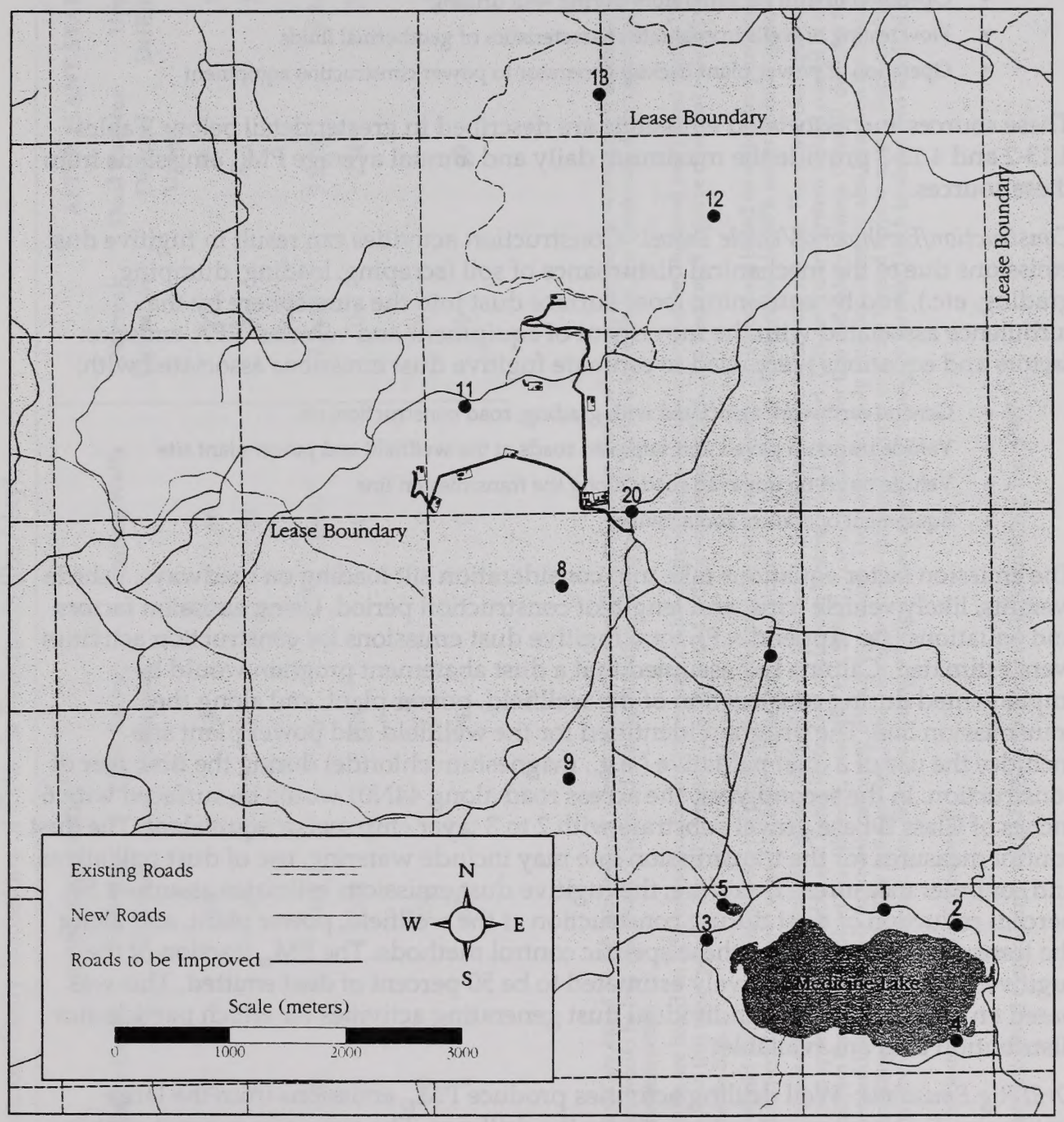


Figure 4.13-2: Locations of Model Receptors Near the Project Site



Sources and Emissions: PM_{10} (including fugitive dust) emissions during construction of the wellfield, power plant, and transmission line would result from:

- Ground-disturbing activities during construction
- Construction equipment and vehicle operation on dirt roads
- Operation of drill rig generators during well drilling
- Flow testing of wells to evaluate characteristics of geothermal fluids
- Operation of power plant backup generator to power construction equipment

These sources and associated emissions are described in greater detail below. Tables 4.13-2 and 4.13-3 provide the maximum daily and annual average PM_{10} emissions from these sources.

Construction/Earthwork/Vehicle Travel: Construction activities can result in fugitive dust emissions due to the mechanical disturbance of soil (scraping, loading, dumping, grading, etc.), and by entraining loose surface dust into the atmosphere by the turbulence associated with the movement of equipment and vehicles. EPA emission factors and equations were used to estimate fugitive dust emissions associated with:

- General earthwork associated with grading, road construction, etc.
- Vehicle travel on paved and unpaved roads at the wellfield and power plant site
- Vehicle travel on unpaved roads along the transmission line
- Equipment operation and activities

The emission factor equations take into consideration silt loading on roadways, vehicle weights, likely vehicle trips, and length of construction period. Using emission factors and equations (see Appendix F), total fugitive dust emissions for construction activities were estimated. Calpine has assumed that a dust abatement program would be implemented during construction of the wellfield, power plant, and along the transmission line. The program identified for the wellfield and power plant site includes the use of a dust palliative (e.g., magnesium chloride) during the first year of construction. In the second year, the access road along 44N01 would be surfaced with 6 inches of Class II base gravel substrate with 2 to 3 layer chip seal or equivalent. The dust control measures for the transmission line may include watering, use of dust palliatives, and/or other measures. Therefore, the fugitive dust emissions estimates assume a 50 percent reduction of dust during construction at the wellfield, power plant, and along the transmission line due to these specific control methods. The PM_{10} fraction of the fugitive dust was conservatively estimated to be 50 percent of dust emitted. This was based on data obtained for individual dust generating activities for which particle size distribution data are available.

Drill Rig Emissions: Well drilling activities produce PM_{10} emissions from the large stationary diesel generators which power the drill rigs. The generator exhaust contains particulate matter in the form of soot, as well as oxides of nitrogen, oxides of sulfur, carbon monoxide, and various organic gases.

Emissions from drill rig generators were estimated using EPA emission factors for heavy-duty stationary diesel engines, the total horsepower of the engines used in the generators of a typical drill rig (2,550 bhp), and average loading factors for the

Table 4.13-2: Maximum Daily Emissions of Criteria Pollutants (lbs/day)

Criteria Pollutant	CONSTRUCTION[a]				AFTER PLANT STARTUP			
	Fugitive Dust[b]	Drill Rig Engines	Plant Backup Generator	Venting Wells	Normal Operation[c]	Dual Turbine Outage Upset[d]	Upset + Drilling Well	Upset + 2 Wel Venting
PM_{10}	107	86	13	16	27	75	56	91
Hydrogen Sulfide	0	0	0	38	39	37	37	76
Lead	0	0	0	$1.0x10^{-4}$	$2.5x10^{-5}$	$9.3x10^{-4}$	$9.3x10^{-4}$	$2.0x10^{-4}$
Nitrogen Oxides	0	1,591	234	0	0	234[e]	764	234
Sulfur Oxides	0	50	7	0	0	7	24	7
Carbon Monoxide	0	673	99	0	0	99	323	99

Notes:

[a] Construction emissions are based on the third year of construction at the wellfield and power plant, which represents the worst-case conditions. Emissions during the first and second years would be less as a result of reduced drilling activities. See Appendix F, Tables 6 through 11, for maximum daily construction emissions for each of the three years of construction.

[b] Fugitive dust emissions are based on EPA emissions factors and equations for earthmoving activities and travel on unpaved and paved roads. The emissions are also based on the assumption that the proposed dust abatement program would reduce emissions by 50%. The fraction of fugitive dust that would be composed of PM_{10} would be approximately 50%.

[c] Normal operations would include emissions from the plant cooling tower and the plant vent silencer. Emissions are based on estimates provided by Calpine and the assumption that a direct-contact condenser would be used. H_2S control efficiency of direct contact condenser would be 95% under normal operating conditions.

[d] During a dual-turbine outage, bypass unavailable upset, 100% of steam flow would be directed to the plant vent silencer. The worst-case upset conditions evaluated assumes that the bypass system is unavailable and that a secondary abatement system would be used. This secondary system would consist of injection of caustic material prior to emission through the plant vent silencer, resulting in a 80% H_2S control efficiency for this secondary system. Overall, the total H_2S emission value during plant upsets would be comparable to emissions during normal operations. The maximum daily emission rates are also based on the assumption that steam flow is not reduced by throttling back the wells. The full flow would be vented through the plant silencer until the time of turbine restart. Such conditions would only occur if it is anticipated that the upset would last less than 24 hours. During a longer upset, steam flow would be throttled back to about two-thirds of full flow until turbine restart.

[e] Emissions from the back-up generator during an upset.

SOURCE: Precise Environmental Consultants and MHA Environmental Consulting, Inc. 1997.

Table 4.13-3: Annual Average Emissions of Criteria Pollutants (tons/year)

Criteria Pollutant	Construction[a]	After Plant Start Up[b]
PM_{10}	15.4	4.5
Hydrogen Sulfide	1.2	7.2
Lead	3.3×10^{-6}	4.8×10^{-6}
Nitrogen Oxides	99.3	7.0
Sulfur Oxides	3.1	0.2
Carbon Monoxide	42.0	2.9
Total	**161.0**	**21.9**

Notes:

[a] Annual average construction emissions are based on the third year of construction at the wellfield and power plant which represents the worst-case conditions. Emissions during the first and second years would be less as a result of reduced drilling activities. See Appendix F, Tables 12 through 17, for annual average emissions for each of the three years of construction.

[b] Annual average emissions of criteria pollutants after plant start up are based on normal operations and on expected upset conditions for short-term upsets, planned outages, and long-term upsets (quantified based on the average number of upset hours per year). Likewise, the contribution of infill well drilling and flow testing to annual average emissions was quantified based on the expected average hours for each in a given year.

SOURCE: Precise Environmental Consultants and MHA Environmental Consulting, Inc., 1997

maximum hourly and daily emissions. The average loading factors of 67 percent for the maximum hourly and daily emissions and 33 percent for the average daily emissions, overestimate likely emissions from drill rigs; therefore, emissions from this source are considered worst-case and conservative. These factors were also used to estimate the emissions of the power plant backup generator, described below.

Flow Testing Wells: Geothermal wells would be tested to determine the characteristics of the geothermal reservoir and the production capacity of each individual well. Flow testing involves opening the well valves and allowing the steam to vent and the hot water to flow to a sump. The flow of the geothermal fluids would be directed from the wellhead to a flash tank (where the gas and liquid phases are separated) and then to a portable silencer.

The geothermal emissions to the atmosphere during flow testing are primarily steam (water vapor). The steam includes minor amounts of particulate matter and other constituents of the geothermal steam. The flash tank and the silencer serve to minimize the amount of water droplets emitted, and therefore minimize the particulate matter. The amount of particulates entrained in the steam emissions is believed to be low. In addition, most of the water droplets (which contain dissolved solids) generally fall out on the well pad.

The emissions estimate for well venting were provided by Calpine, based on the expected chemical composition of the geothermal resource, well production rates, and gas/water separation efficiencies in the equipment. The emission estimates are considered conservative and probably overestimate the emissions, as gas/water separation efficiencies may be higher and the fall-out of water droplets at the site is not accounted for, both of which would reduce PM_{10} emissions.

Plant Backup Generator: During plant construction, the plant backup generator would supply power for construction tools and equipment until the transmission line is completed and on-line. The generator emissions would be similar to those emitted from the drill rig generators.

PM_{10} Concentrations at Adjacent Receptors: Table 4.13-4 presents the results of the dispersion modeling conducted to evaluate potential project emission impacts on 24-hour average ambient PM_{10} concentrations. Results of the modeling indicate that the maximum impact during the construction of the wellfield and power plant would occur at receptor 20 (located on Primary Forest Route 49, near the plant site) during the first year of construction when the majority of the earthwork and road construction would occur. The estimated maximum impact of the project at this receptor would result in a 24-hour average PM_{10} concentration of about 21 $\mu g/m^3$. This concentration, when added to typical background concentrations, is below the Federal and state 24-hour average standards of 150 $\mu g/m^3$ and 50 $\mu g/m^3$ (respectively). All other adjacent receptor locations would have lower PM_{10} concentrations as a result of wellfield and power plant construction. Exceedances of the state 24-hour PM_{10} standard could, however, occur in close proximity to wellfield and power plant construction activities.

The results of the modeling of transmission line construction dust emissions on ambient PM_{10} concentrations are presented in Table 4.13-5. These impacts were analyzed for a worst-case construction scenario on a segment of the transmission line corridor in any orientation. The results are presented as maximum 24-hour concentrations associated with the transmission line construction during the first year (right-of-way clearing) and the second year (construction) for various distances from the right-of-way centerline. The analysis assumed the combination of the worst-case scenario of activities and the worst-case meteorological conditions, which would produce the highest estimated concentration for any receptor at the stated distance from the right-of-way. Under more favorable meteorological conditions, and to the extent that construction activities would not be carried out in close proximity to one another, the actual impacts would be expected to be lower. The analysis assumed no fugitive dust emissions abatement for these activities.

The analysis indicates that, like most construction projects involving land clearing and travel over unpaved surfaces, fugitive dust emissions associated with the construction of the transmission line could cause exceedances of the state 24-hour PM_{10} standards at locations close to the construction activities. Exceedances of this standard could occur within approximately 250 feet of the right-of-way center line. The Medicine Lake campgrounds (receptors 1 and 2) would not be expected to experience short-term exceedances of the PM_{10} standard as these receptors would be at least 400 feet away from the edge of the transmission line right-of-way. Exceedances of the state 24-hour

Table 4.13-4: Maximum 24-Hour and Annual Average Concentrations of PM_{10} at Adjacent Receptors ($\mu g/m^3$)[a]

Receptor # and Location	CONSTRUCTION (24-Hour Average)[b]	CONSTRUCTION (Annual Average)	AFTER PLANT STARTUP (24-Hour Average) Normal Operation	Normal Operation + One-Well Drilling	Dual Turbine Outage Upset	Worst-Case Impact After Plant Start-up	AFTER PLANT STARTUP (Annual Average)
3. Medicine Lake Campground HQ	1.7	0.037	0.04	0.8	0.1	0.9	0.006
4. Medicine Lake Cabins	1.1	0.021	0.1	0.6	0.1	0.6	0.006
5. Little Medicine Lake	1.7	0.043	0.1	0.8	0.2	1.1	0.008
7. Medicine Lake Glass Flow	3.1[c]	0.120	0.2	1.9	0.5	2.1	0.025
8. Grouse Hill	8.7	0.301	1.2	6.5	4.2	7.6	0.074
11. Goshawk Nest	9.9[c]	0.441	0.5	5.7	0.6	5.9	0.090
12. Fourmile Hill	2.2[c]	0.115	0.4	2.2	1.5	2.5	0.052
20. FR 49 near plant	20.5[c]	1.647	1.2	16.4	3.7	16.9	0.350

Notes:

[a] The State and Federal 24-hour PM_{10} standards are 50 $\mu g/m^3$ and 150 $\mu g/m^3$, respectively. The state and Federal annual average PM_{10} standards are 30 $\mu g/m^3$ and 50 $\mu g/m^3$, respectively.

[b] The 24-hour average PM_{10} concentrations provided for these receptors are the worst-case calculated, based on both the first and third years of construction.

[c] The concentrations marked with an asterisk(*), would occur during the first year of construction due to their proximity to ground disturbing activities. The concentrations for the other identified receptors would result during the third year of construction due to their proximity to well drilling and venting activities.

SOURCE: Precise Environmental Consultants and MHA Environmental Consulting, Inc. 1997

Table 4.13-5: Estimated Maximum 24-Hour Average PM_{10} Concentration During Transmission Line Construction[a]

Distance from ROW Centerline	Estimated Maximum 24-Hour PM_{10} Concentration ($\mu g/m^3$)[b]	
Feet	Year 2	Year 3
164	63.3	68.5
328	33.5	25.4
656	17.2	8.2
1,640	6.5	2.1
3,280	2.8	0.8
6,560	1.1	0.4
16,400	0.4	0.2
32,800	0.2	0.1

Notes:

[a] PM_{10} concentrations should be compared against the Federal 24-hour PM_{10} standard of 150 $\mu g/m^3$ and the state 24-hour PM_{10} standard of 50 $\mu g/m^3$.

[b] Estimated concentrations do not include the application of dust control measures such as those applied for the wellfield and power plant site.

SOURCE: Precise Environmental Consultants, 1997 and MHA Environmental Consulting, Inc.

PM_{10} standard would also not occur in Tionesta (Receptor 16) as the closest house is approximately 1,500 feet from the transmission line right-of-way.

As noted above, wellfield, power plant, and transmission line construction would not result in exceedances of the 24-hour PM_{10} standard at any adjacent receptor locations. Likewise, no combination of construction activities (wellfield, power plant, and transmission line) were found to produce PM_{10} concentrations exceeding or approaching the annual PM_{10} standards at adjacent receptor locations. The results of the annual average PM_{10} impact analysis for construction of the wellfield and power plant are presented in Table 4.13-4. Construction would not result in significant impacts from PM_{10} emissions at any of the identified receptor locations. There could be a significant short-term, localized impact to air quality in close proximity to construction activities, as the state 24-hour PM_{10} standard could be exceeded.

Mitigation Measures

Implementation of the mitigation measures below would reduce PM_{10} emissions from construction activities, including drilling.

4.13.1a Calpine shall be required to design and implement measures to control the generation of dust during wellfield, power plant, and transmission line construction. The measures shall be applied during the construction season after the ground becomes dry. Such measures shall be reviewed and

approved by the SCAPCD and the USFS and could include, but would not be limited to the following measures:

- Apply water or dust palliative (i.e. magnesium chloride) to all active construction areas where soil disturbance is occurring; the amount of watering shall depend on the soil moisture content and the weather conditions
- For exposed construction soil stockpiles or inactive construction areas where soil disturbance has occurred, vegetate, enclose, water, or treat with dust palliative
- Limit construction vehicle speeds to 25 miles per hour or less on all unpaved roads
- Cover all construction trucks hauling loose materials that would travel off forest roads (C, D)

Level of Significance After Mitigation

Significant and unavoidable on a short-term basis.

4.13.2 Effects of Construction H_2S Emissions

The construction phase of the proposed project, which includes well flow testing H_2S emissions, would not exceed the state H_2S standard at adjacent receptors, and would not result in significant impacts on ambient air quality.

H_2S Sources and Emissions: H_2S emissions during project construction would result from well venting during drilling and flow testing. Emissions estimates from wells were developed and provided by Calpine based on the expected composition of the geothermal resource, and expected well flow rates. Tables 4.13-2 and 4.13-3 provide the maximum daily and annual H_2S emissions from well venting operations during construction.

Because the concentrations of H_2S in the geothermal fluids are expected to be quite low, it is anticipated that abatement of H_2S emissions from the wellhead during flow testing will not be necessary. If higher-than-expected H_2S concentrations are encountered, wellhead abatement or other measures may be needed, as described below in Mitigation Measure 4.13.2a.

H_2S Concentrations at Adjacent Receptors: Well drilling and testing would not result in any exceedances of the state 1-hour H_2S standard; there are no Federal H_2S ambient standards. As shown in Table 4.13-6, the estimated maximum one-hour average H_2S concentration of 13.9 $\mu g/m^3$ would occur at Grouse Hill (receptor 8) in the second and third years of construction, which was the highest concentration calculated due to the number of wells to be tested. This concentration would be below the state H_2S standard of 42 $\mu g/m^3$. Background H_2S concentrations in the area are believed to be negligible, so the project is not expected to cause or contribute to an exceedance of the state standard during any of the three years of construction.

Odor complaints would also not be likely to occur as H_2S concentrations would be below the state standard (which is also considered an odor nuisance threshold) and due to the expected limited number of people exposed. Therefore, the impact of project H_2S emissions during construction on ambient air quality would not be significant.

Table 4.13-6: Maximum One-Hour H_2S Concentrations of Adjacent Receptors ($\mu g/m^3$)[a]

Receptor # and Location	CONSTRUCTION	AFTER PLANT STARTUP			
	Well Testing[b]	Normal Operation	Normal Operation + 2 Wells Venting	Dual Turbine Outage Upset	Upset + 2 Wells Venting
3. Medicine Lake Campground HQ	2.2	0.3	2.3	0.3	2.3
4. Medicine Lake Cabins	1.6	0.4	1.6	0.4	1.6
5. Little Medicine Lake	2.2	0.3	2.4	0.3	2.4
7. Medicine Lake Glass Flow	3.2	0.7	3.7	0.5	3.7
8. Grouse Hill[c]	13.9	15.7	29.5	16.6	30.3
11. Goshawk Nest	2.1	1.8	2.1	0.5	2.1
12. Fourmile Hill	5.9	6.3	11.1	8.5	13.3
20. FR 49 near plant	8.8	14.7	21.8	5.2	10.1

Notes:

[a] State 1-hour H_2S standard is 42 $\mu g/m^3$. There are no Federal standards for H_2S.

[b] Worst-case H_2S concentrations would occur during the third year of construction, when up to 2 wells could be vented concurrently. H_2S concentrations during the first and second years of construction would be less (as shown in Appendix F, Table 30).

[c] Receptor 8–Grouse Hill is the point of maximum impact for H_2S during all phases of project construction and operation.

SOURCE: Precise Environmental Consultants and MHA Environmental Consulting, Inc. 1997.

Mitigation Measures

While not required to reduce a non-significant impact, implementation of the mitigation measures below would ensure that H_2S exceedances do not occur.

4.13.2a H_2S emissions during flow testing shall be monitored and the results reported to the APCD on a schedule approved by the APCD. If the monitoring reveals emissions in exceedance of the APCD's emission limitation, the APCD could require additional control measures to ensure compliance with the emission limitation. Additional control measures could include, but would not be limited to, the following:

- Reduce the number of wells venting simultaneously
- Implement additional wellhead abatement measures, such as caustic injection between the flash tank and the portable silencer (C, O)

Level of Significance After Mitigation

Less than significant.

4.13.3 Effects of Construction Emissions of Other Criteria Pollutants

Construction of the proposed project would not result in any exceedances of state or Federal ambient air quality standards for SO_x, NO_x, CO, and lead. Therefore, project construction would not result in significant impacts associated with these criteria pollutant emissions.

Sources and Emissions: Except for minor emissions from vehicles, SO_x, NO_x, and CO would be emitted only from the rig engines during the drilling of wells and from the plant backup generator, which would be used during construction to provide power for construction equipment. Well venting would contribute trace amounts of lead. Tables 4.13-2 and 4.13-3 provide the maximum daily and annual average emissions of these criteria pollutants during construction.

Concentrations at Adjacent Receptors: The estimated concentrations of the criteria pollutants at adjacent receptor locations during construction would be well below their respective state and Federal standards. As project construction would not be expected to cause or contribute to an exceedance of any of these standards, no significant or adverse impacts would occur. Appendix F provides the estimated concentrations of these pollutants during project construction at adjacent receptor locations.

Mitigation Measures

No mitigation measures would be required as no significant or adverse impacts would occur.

4.13.4 Effects of Operation PM_{10} Emissions

During normal operations and upset conditions, the proposed project would not cause or contribute to an exceedance of the state or federal 24-hour PM_{10} standard. Therefore, no significant impact would result from PM_{10} emissions during project operation.

PM_{10} Sources and Emissions: PM_{10} emissions during project operation would result primarily from:

- The cooling tower during normal operations only

- The plant vent silencer during both normal and upset conditions
- Drilling of infill wells
- Venting wells through portable silencers during maintenance or during an upset
- The plant backup generator during a planned plant shut down or during an upset

Tables 4.13-2 and 4.13-3 provide the maximum 24-hour and annual PM_{10} emissions from these sources, which are also described below.

Cooling Tower: The cooling tower would emit cooling tower "drift" and non-condensable gases during normal operations. Drift is composed of water droplets, which contain dissolved solids. At the top of all modern cooling towers, just below the fans, are drift eliminators. The eliminators are devices that serve to remove most of the droplets from the exhaust stream and return them to the circulating water in the tower. The remaining drift which escapes the drift eliminators would contain some of the dissolved and suspended solids in the geothermal brine carried over from the primary and secondary flash tanks, through the turbines, and into the water of the condenser.

Calpine has estimated emissions of particulate matter from this source during normal operations, based on their knowledge of the geothermal resource characteristics and known equipment efficiencies. Most of the dissolved and suspended solids in the geothermal resource would remain in the liquid phase and would be returned to the geothermal reservoir through injection wells. The Calpine emission estimates assume that all dissolved and suspended solids would be emitted to the atmosphere as PM_{10}. This assumption is highly conservative as it does not account for the removal of these solids from the cooling tower drift due to deposition of large droplets.

Plant Vent Silencer: Under normal operations, the plant vent silencers would receive the low pressure liquids from the second flash, where they would flash once again. During upset conditions (assuming a dual turbine outage, bypass unavailable upset) 100 percent of steam flow would be directed to the silencers. Silencers are large cylindrical vessels that allow steam to expand and decelerate before being released to the atmosphere. As described for the portable silencers, the plant silencers would remove most of the remaining liquids from the flow, but would allow a small fraction (one percent or less) to be carried over as droplets in the exhaust stream. These droplets would contain some particulate matter; again, the emissions were developed with the conservative assumption that all dissolved solids would be emitted to the atmosphere as PM_{10}.

Drilling of Infill Wells: Infill well drilling would also result in the emissions of particulate matter from drill rig diesel generators and from well flow testing. The emissions sources for drilling these wells would be the same as those discussed above for drilling during the initial development of the wellfield in the construction phase of the project.

Venting Wells through Portable Silencers: Occasionally, it would be necessary to vent wells through portable silencers. Under normal operating conditions venting would occur only when a portion of the pipeline to the power plant is unavailable for some reason, e.g., repair or maintenance. In such cases, the geothermal fluids would be directed to a flash tank and portable silencer combination, with water injection for

particulate matter control. Emissions during these situations would be the same as during flow testing of production wells prior to power plant startup.

Plant Backup Generator: The plant backup generator would emit PM_{10} during normal operations if tested during routine maintenance; generator emissions would also occur during a dual-turbine plant upset. During an upset, the plant backup generator would be used to produce plant power sufficient to maintain the plant in standby mode.

PM_{10} Concentrations at Adjacent Receptors: The dispersion modeling of emissions indicates that after plant startup, the impact of the power plant during both normal operation and upset conditions would result in very low PM_{10} concentrations at all receptors. Table 4.13-4 shows the maximum 24-hour and annual average PM_{10} concentrations during normal operations and upset conditions.

Under normal plant operation conditions, the maximum estimated 24-hour average PM_{10} concentration would less than 2 $\mu g/m^3$ at receptor 8 (Grouse Hill). PM_{10} concentrations from the all sources during infill well drilling, would result in a maximum estimated 24-hour average PM_{10} concentration of about 17 $\mu g/m^3$ at Receptor 20 (Forest Road 49). The estimated maximum impact of the project during upset conditions while conducting well drilling would result in a 24-hour average PM_{10} concentration of about 17 $\mu g/m^3$ at receptor 20. These maximum estimated impacts, when added to typical background PM_{10} concentrations in the project area, are below the state (50 $\mu g/m^3$) and Federal (150 $\mu g/m^3$) 24-hour average PM_{10} standards.

Additionally, none of the modeled impacts of the project are sufficient to cause or contribute to the exceedance of the state or Federal annual PM_{10} standards.

Mitigation Measures

No mitigation measures would be required as no significant or adverse impacts would occur.

4.13.5 Effects of Operation H_2S Emissions

Normal operation or upset conditions of the proposed wellfield and power plant site would not produce emissions of H_2S in exceedance of the state 1-hour standard. Therefore, no significant impact would result from H_2S emissions during project operations.

H_2S Sources and Emissions: During normal project operation, H_2S would be emitted from the cooling tower and the plant vent silencer. During upset conditions, H_2S would be emitted primarily from the plant vent silencer.

Normal Operation: During normal plant operation, H_2S would be emitted from the cooling tower and the plant vent silencer (where the low pressure liquids are directed). H_2S is a noncondensable gas that would be treated in an H_2S abatement system (such as a Stretford system, see Chapter 2). Although most of the H_2S treated in the gas treatment system and secondary abatement system, some H_2S would be emitted from the cooling tower. The proposed project design includes the use of a direct-contact condenser, which uses steam condensate sprayed directly on the steam to condense the steam to liquid after the steam exits the turbine. The condensed steam would then be routed to the cooling tower to be used in the condenser for cooling. The direct-contact

condenser would result in a larger portion of the noncondensable gas (including H_2S) being entrained in the cooling water than would occur with a surface condenser; some of these constituents would then be emitted from the cooling tower.

The direct-contact condenser has a lower partitioning (separation) rate (direct contact partitioning approximately 60 to 70%; surface condenser partitioning approximately 85 to 90%) for H_2S but is less subject to fouling, has a higher thermodynamic efficiency which results in a more efficient use of the resource, and is less expensive than a surface condenser.

Plant Upset Conditions: Plant upset conditions would occur as a result of equipment or transmission line failure (as described previously in this section, under "Scenarios Evaluated"). During the worst-case upset conditions (assuming a dual turbine outage, by-pass unavailable upset), 100 percent of the steam flow would be directed to the plant vent silencer. In this situation, H_2S emissions would be abated by backup abatement system that would inject hydrogen peroxide or a caustic solution into the produced steam at a point prior to the plant silencer. The backup abatement system would provide about 80% H_2S control efficiency. The air quality impacts presented for plant upset conditions represent the worst-case impact of full steam flow to the vent silencer from all production wells with the backup H_2S abatement in operation. Such conditions would occur when an upset would be expected to last less than 24 hours. Calpine has indicated that they would reduce flow to about two-thirds of full flow over eight hours by throttling back the wells for upsets lasting longer than 24 hours. The BLM and USFS have indicated that they would require a more aggressive flow reduction procedure to protect the geothermal resource and to minimize H_2S emissions, as identified in Mitigation Measure 4.13.5c, below.

Tables 4.13-2 and 4.13-3 provide the maximum daily and annual H_2S emissions from the cooling tower and plant vent silencer during normal operations and upset conditions.

H_2S Concentrations at Adjacent Receptors: Table 4.13-6 presents the estimated maximum one-hour average H_2S concentrations associated with normal and upset operation of the project. These results indicate that the project would not cause exceedances of the state one-hour average H_2S standard. The estimated maximum concentration of H_2S at Grouse Hill (receptor 8) under normal operating conditions (with 2 wells venting) is 29.5 $\mu g/m^3$. The estimated maximum concentration at this receptor under upset operating conditions with two wells venting is 30.3 $\mu g/m^3$. These concentrations would not exceed the state standard of 42 $\mu g/m^3$. Odor complaints would also not be likely to occur as H_2S concentrations would be below the state standard, and due to the expected infrequency of human presence in the area. H_2S levels at greater distances would be lower under both normal and upset conditions; therefore, no significant impacts would result.

Mitigation Measures

While not required to reduce a non-significant impact, Mitigation Measure 4.13.2a above, and the mitigation measures below would minimize H_2S emissions and ensure that H_2S exceedances do not occur.

4.13.5a If during initial well drilling H_2S concentrations in the geothermal resource exceed the expected concentration of 8 ppm, H_2S emissions should be re-

modeled to determine H_2S concentrations at adjacent receptors and the potential for exceedances of the state 1-hour standard. Additional mitigation measures to control H_2S may be required, such as the use of a surface condenser instead of a direct-contact condenser. (C, O)

4.13.5b Log plant operations after startup to document actual frequency and duration of upset conditions. This information would be used in conjunction with monitoring of H_2S concentrations to evaluate the effectiveness of H_2S abatement systems. If significant impacts are measured, additional abatement measures would be required that are acceptable to the agencies. (O)

4.13.5c Calpine shall be required to throttle back the wells to 50 percent of full flow after 1 hour of full-flow venting. After 6 hours, Calpine shall further reduce flow (if possible without damaging the well casings and/or killing the wells) to a level that meets SCAPCD emission requirements for H_2S. Calpine shall evaluate the potential to further reduce flow by collecting operational information during the initial year of wellfield production and over the long term. (O)

Level of Significance After Mitigation

Less than significant.

4.13.6 Effects of Operation Emissions of Other Criteria Pollutants

Normal project operation and upset conditions would not result in significant or adverse impacts as exceedances of state or Federal SO_x, NO_x, CO, and lead standards would not occur.

Sources and Emissions: For normal operations after plant startup, there would be no significant sources of SO_x, NO_x, CO, or lead emissions. Except for minor emissions from vehicles, SO_x, NO_x, and CO would be emitted only during the drilling of infill wells (from the rig generators) and from the plant's diesel backup generator when it is tested during routine maintenance and used during an upset.

Concentrations at Adjacent Receptors: The estimated SO_2, NO_2, CO, and lead concentrations at adjacent receptor locations for both normal and upset operating conditions are well below their respective state and Federal standards. As the project would not be expected to cause or contribute to an exceedance of any of these standards, no significant or adverse impacts would occur. Appendix F provides the estimated concentrations of these pollutants during project operation.

Mitigation Measures

No mitigation measures would be required as no significant or adverse impacts would occur.

4.13.7 Effects of Decommissioning PM_{10} Emissions

Decommissioning of the proposed wellfield, power plant, and transmission line facilities would not result in significant impacts at adjacent receptor locations, as the state 24-hour and annual PM_{10} standards would not be exceeded. This impact would therefore be less than significant.

Sources and Emissions: Fugitive dust emissions during decommissioning of the wellfield, power plant, and transmission line would result primarily from ground-disturbing activities related to vehicle travel and earthwork. Tables 4.13-2 and 4.13-3

provide the maximum daily and annual average PM_{10} emissions from these sources during construction, which would be similar to those for decommissioning.

PM_{10} Concentrations at Adjacent Receptors: Potential project impacts during decommissioning of the wellfield and power plant site would be similar to those described above for construction (See Impact 4.13.1) as equipment types and numbers, as well as duration of activities, would be similar. The project emissions, when added to background concentrations, would not exceed the state or Federal PM_{10} standards.

Decommissioning of the transmission line would also result in emissions similar to construction of the line, in terms of PM_{10} impacts. Based on the analyses conducted for construction, fugitive dust emissions associated with the decommissioning of the transmission line could cause exceedances of the state and Federal 24-hour PM_{10} standards at locations close to the activities under worst-case meteorological conditions. Exceedances of this standard could occur within about 250 feet of the transmission line right-of-way centerline. No exceedances, however, would occur at identified receptors.

No combination of decommissioning activities (wellfield, power plant, and transmission line) would likely produce estimated ambient PM_{10} concentrations exceeding or approaching the state or Federal annual PM_{10} standards.

Mitigation Measures

While not required to reduce a significant impact, implementation of Mitigation Measure 4.13.1a, above, would reduce PM_{10} emissions from decommissioning activities.

Level of Significance After Mitigation

Less than significant.

4.13.8 Effect on Public Health

The proposed action would not result in any significant or adverse effects on public health as a result of project emissions during construction, operation, and decommissioning.

To determine whether the proposed project has the potential to cause health risks due to air pollutant emissions, calculations for criteria and non-criteria pollutant concentrations were conducted to evaluate cancer risk and acute and chronic health effects of the proposed project. Tables 4.13-7 and 4.13-8 provide maximum daily and annual emission of non-criteria pollutants. The excess lifetime cancer risk, chronic total hazard index, and acute total hazard index were calculated using the procedures outlined in the *CAPCOA Risk Assessment Guidelines* (CAPCOA 1993). The results of these calculations are summarized briefly below. Additional technical information related to the methodology for the calculations and other technical information is provided in Appendix F.

Excess Cancer Risk: Estimated excess lifetime cancer risk is determined based on Unit Risk Factors (URFs) for substances that are known or suspected carcinogens, in conjunction with anticipated lifetime exposure to emissions of such carcinogens (assumes a 70-year exposure time frame). Annual concentrations of suspected carcinogens from the operation of the wellfield and power plant were used in this

Table 4.13-7: Maximum Daily Emissions of Non-Criteria Pollutants (lbs/day)

Substance	Construction[a]	After Plant Startup	
		Normal Operations[b]	Dual Turbine Outage Upset[c]
Antimony	3 9.6x10^{-4}	2.3x10^{-4}	8.6x10^{-4}
Arsenic	3.1x10^{-2}	6.9x10^{-3}	2.8x10^{-2}
Beryllium	1.0x10^{-5}	2.5x10^{-6}	9.3x10^{-6}
Cadmium	1.0x10^{-5}	2.5x10^{-6}	9.3x10^{-6}
Chromium	1.0x10^{-5}	2.5x10^{-6}	9.3x10^{-6}
Cobalt	1.0x10^{-5}	2.5x10^{-6}	9.3x10^{-6}
Manganese	4.2x10^{-5}	1.0x10^{-5}	3.7x10^{-5}
Mercury	4.1x10^{-2}	6.6x10^{-4}	2.1x10^{-1}
Nickel	4.2x10^{-5}	1.0x10^{-5}	3.7x10^{-5}
Selenium	1.0x10^{-5}	2.5x10^{-6}	9.3x10^{-6}
Boron	9.6x10^{-2}	2.5x10^{-2}	8.6x10^{-2}
Ammonia	5.7	9.5x10^{1}	1.2x10^{2}
Volatile Organic Compounds	4.2	3.6x10^{-1}	4.4x10^{1}
Radon	3.0x10-10	1.5x10^{-9}	1.5x10^{-9}
Copper	1.3x10^{-10}	3.3x10^{-6}	1.2x10^{-5}
Zinc	5.0x10^{-5}	1.2x10^{-4}	4.5x10^{-4}
Asbestos	2.1x10^{-4}	5.0x10^{-5}	1.9x10^{-4}
Benzene	2.2x10^{-2}	4.7x10^{-1}	4.7x10^{-1}
Toluene	1.6x10^{-1}	8.2x10^{-1}	8.2x10^{-1}
1,3 & 1,4 - Xylene	1.3x10^{-2}	1.3x10^{-1}	1.3x10^{-1}
1,2 - Xylene	4.8x10^{-3}	4.7x10^{-2}	4.7x10^{-2}
Hydrochloric acid	2.1x10^{-6}	5.0x10^{-7}	1.9x10^{-6}

Notes:

[a] Emissions provided are for two portable silencer in operation during construction-phase well testing. Only one well would be tested at a time during the first year of construction.

[b] Emissions during normal operation of the plant would result from the plant cooling tower and the plant vent silencer. Appendix F, Table 1 provides the emissions for each of these sources.

[c] Emissions during upset plant conditions would result from only the plant vent silencers as 100% of the steam flow would be directed to the silencers. Maximum daily emissions are based on a dual-turbine, bypass-unavailable upset with implementation of a backup abatement system (caustic injection). The maximum daily emission rates are also based on the assumption that steam flow is not reduced by throttling back the wells. The full steam flow would be vented through the plant silencer until the time of turbine restart. Such conditions would only occur if it is anticipated that the upset would last less than 24-hours. During a longer upset, steam flow would be throttled back to about two-thirds of full flow until turbine restart.

SOURCE: Precise Environmental Consultants and MHA Environmental Consulting, Inc. 1997.

Table 4.13-8: Annual Emissions of Non-Criteria Pollutants (lbs/year)

Substance	Construction[a]	After Plant Startup[b]
Antimony	6.0×10^{-2}	8.9×10^{-2}
Arsenic	2.0	2.6
Beryllium	6.5×10^{-4}	9.6×10^{-4}
Cadmium	46.5×10^{-4}	9.6×10^{-4}
Chromium	6.5×10^{-4}	9.6×10^{-04}
Cobalt	6.5×10^{-4}	9.6×10^{-4}
Manganese	2.6×10^{-3}	3.9×10^{-03}
Mercury	2.6	9.6×10^{-1}
Nickel	2.6×10^{-3}	3.9×10^{-3}
Selenium	6.5×10^{-4}	9.6×10^{-4}
Boron	6.0	8.9
Ammonia	360	34,825
Volatile Organic Compounds	266	12,978
Particulate Matter		
Copper	8.5×10^{-4}	1.3×10^{-3}
Radon	1.9×10^{-8}	5.3×10^{-7}
Zinc	3.1×10^{-2}	4.6×10^{-2}
Asbestos	1.3×10^{-2}	1.9×10^{-2}
Benzene	1.4	170
Toluene	10	298
1,3 & 1,4 - Xylene	8.1×10^{-1}	46
1,2 - Xylene	3.0×10^{-1}	17
Hydrochloric Acid	1.3×10^{-4}	1.9×10^{-4}

Notes:

[a] Construction emissions from well venting are based on the third year of construction at the wellfield which represents the worst-case conditions. Emissions during the first and second years would be less as a result of reduced drilling and testing activities. See Appendix F, Table 5 for annual emissions from well drilling for each of the three years of construction.

[b] Annual average emissions after plant startup are based on normal operations and on expected upset conditions for short-term upsets, planned outages, and long-term upsets (quantified based on the average number of upset hours per year). Likewise, the contribution of infill well drilling and flow testing to annual average emissions was quantified based on the expected average hours for each in a given year.

SOURCE: Precise Environmental Consultants and MHA Environmental Consulting, Inc., 1997.

analysis. Annual emissions during construction and decommissioning were not evaluated due to the short-term nature of these activities.

The estimated excess lifetime cancer risk for each receptor location indicates that the estimated excess lifetime cancer risk is less than one cancer case per million persons exposed (ranging from approximately 0.0002 in one million to 0.09 in one million), which is below the threshold used in most, if not all, air districts and other regulatory agencies in determining significant cancer risks. Table 4.13-9 provides a summary of the cancer risks at the six closest receptor locations.

Total Chronic Hazard Indices: The total chronic hazard indices were calculated by dividing the annual average concentrations of each substance at receptor locations by the corresponding chronic Reference Exposure Level (REL). Chronic RELs exist only for substances that may produce adverse health effects due to sufficiently high long-term exposures. Annual concentrations of criteria and non-criteria pollutants from the operation of the wellfield and power plant were used in this analysis. Annual emissions during construction and decommissioning were not evaluated due to the short-term nature of these activities.

The total chronic hazard indices were calculated for a range of affected organs or systems (also known as toxicological endpoints), such as the cardiovascular, immune, and respiratory systems to name a few. All of the estimated total chronic hazard indices are much less than one for each receptor, as shown in Table 4.13-9. This table provides the highest index of all of the toxicological endpoints evaluated at each receptor location. The indices indicate that no adverse health effects are expected as a consequence of long-term exposures to emissions from the proposed project at any of the six closest receptor locations.

Total Acute Hazard Indices: Acute RELs exist only for substances that may produce adverse health effects due to sufficiently high short-term exposures. The total acute hazard indices were calculated for a range of affected organs or systems (also known as toxicological endpoints), such as the cardiovascular, immune, and respiratory systems to name a few.

The total acute hazard indices for this project were calculated by dividing the maximum 1-hour average concentrations of each substance at receptor locations by the corresponding acute REL. The maximum 1-hour average concentration would result during a dual turbine, bypass unavailable upset, when concurrent infill well drilling and well venting are occurring.

The estimated total hazard indices associated with the estimated maximum one-hour average concentrations (including criteria pollutants) for the six closest receptors are provided in Table 4.13-9. The indices for all toxicological endpoints, except respiratory irritation, are much lower than 1.0, indicating that no adverse health effects for other organs or organ systems are expected. For respiratory irritation, receptors 8 (Grouse Hill) and 20 (Forest Service Road 49 near the proposed power plant) had estimated acute hazard indices exceeding 1.0 (1.3 and 1.1 for receptors 8 and 20, respectively). The maximum estimated acute hazard indices for the four other nearby receptors were less than 1.0. These calculations are presented and discussed in greater detail in Appendix F, pages F-43 through F-59. For each receptor, the background ambient ozone

Table 4.13-9: Summary of Health Risk Estimates[a]

Receptor # and Location	Estimated Excess Lifetime Cancer Risk[b]	Chronic Total Hazard Indices[c]	Maximum Acute Hazard Indices[d]
Receptor 4–Medicine Lake Cabins	0.004 in 1 million	$1.3x10^{-4}$	$5.9x10^{-1}$
Receptor 5–Little Medicine Lake	0.005 in 1 million	$1.5x10^{-4}$	$6.1x10^{-1}$
Receptor 8–Grouse Hill	0.09 in 1 million	$3.0x10^{-3}$	1.3[e]
Receptor 11–Goshawk Nest	0.004 in 1 million	$1.2x10^{-4}$	$6.1x10^{-1}$
Receptor 12–Fourmile Hill	0.09in 1 million	$3.4x10^{-3}$	$8.9x10^{-1}$
Receptor 20–FR49	0.05 in 1 million	$3.0x10^{-3}$	1.1

Notes:

[a] Appendix F (pages F-43 through F-55) and Tables 32 through 38 provide a detailed health risk assessment. This table is a summary of health risks calculated in this assessment by Suder (1997). Refer to text regarding the significance of the estimated impacts.

[b] Appendix F, Table 35 provides excess lifetime cancer risks for all 22 receptors evaluated, based on a 70-year lifetime exposure.

[c] Appendix F, Table 36 provides Chronic Total Hazard Indices for eight different affected organs or systems. This table provides only the highest (or worst case) of those calculated.

[d] Appendix F, Table 38 provides the maximum Acute Hazard Indices for five different affected organs or systems for the five closest receptor locations. This table provides only the highest (or worst case) index of those calculated.

[e] Appendix F, Table 37 provides estimates of the maximum Acute Hazard Indices for Grouse Hill which takes into consideration background concentrations of criteria pollutants.

SOURCE: Precise Environmental Consultant and MHA Environmental Consulting, Inc. 1997.

concentration contributes 0.56 to the total estimated acute hazard index (For all receptors except 8 and 20, the contribution of background ozone is greater than that from facility-emitted pollutants). The contributions of other background pollutants are negligible.

These results suggest the possibility of respiratory irritation if a person were located in the vicinity of either of these receptors while two wells were venting at one of the production well pads near the power plant, during worst-case meteorological conditions, and either normal power plant operation or a plant upset. However, this effect is not expected to occur, for the following reasons:

- The acute Reference Exposure Level for hydrogen sulfide (used to calculate the contribution of hydrogen sulfide to the total acute hazard index) is several orders of magnitude below levels at which respiratory irritation is likely to occur. The Reference Exposure Level was set equal to the California Ambient Air Quality Standard, which is based on odor, not on respiratory irritation.
- In order to produce an acute hazard index in excess of 1.0, it would be necessary for two wells to be venting on some combination of well pads near the power plant (P-1, P-2 or P-5) during worst-case meteorological conditions. Both well venting and worst-case meteorological conditions individually are expected to occur very infrequently. The joint occurrence of these two events would be extremely infrequent, if it occurred at all.

Worst-case meteorological conditions generally occur at night and are most frequent during the winter months, when background ozone concentrations in the project area are quite low. For any given receptor location, worst-case meteorological conditions must include a wind direction that transports pollutants from the source(s) to the receptor. Grouse Hill is not a heavily used recreation area, and is probably used only rarely (if at all) during the winter or at night. Forest Service Road 49 in the vicinity of receptor 20 is a narrow gravel road. There are no scenic vistas available in this area, and there are no facilities that would provide a reason for travelers to stop for any length of time in this area. Thus, the likelihood of a human being present in the area of either of these two receptors at the same time that the combination of worst-case emissions and a worst-case meteorological scenario occurs is very low. At all other times, the estimated pollutant concentrations would be lower.

The same calculations were completed for the five other receptor locations nearest the proposed project. The results for receptor 20 (the point on Forest Service Road 49 nearest the proposed power plant) were similar to those for receptor 8. For the reasons stated above for receptor 8, the actual maximum concurrent ambient pollutant concentrations would likely be much lower than estimated, and thus the acute hazard index would be much lower.

Acute hazard indices were not calculated for normal operation, construction and decommissioning conditions. As emission and concentrations during these phases would be much less than during the worst-case upset conditions described above, acute hazard indices for these phases would be expected to be much less than one and, therefore, not significant.

Mitigation Measures
No mitigation measures would be required as no significant or adverse impacts would occur.

Level of Significance After Mitigation
Less than significant.

4.13.9 Effect on Visibility

Project emissions of PM_{10} and NO_x during construction could result in a potentially significant, short-term impact on visibility within the adjacent Class I airsheds located in the Lava Beds National Monument. This construction impact could be mitigated, but may remain potentially significant and unavoidable on a short-term basis. No significant or adverse impact on visibility within the adjacent Class I airsheds would occur during operation or decommissioning.

Emissions that Could Contribute to Visibility Impairment: The primary project emissions that could potentially contribute to visibility impairment include particulate matter and NO_x emitted primarily by the diesel generators powering drill rigs and the plant backup diesel generator (NO_x and particulate matter), and venting wells and the plant vent silencer (particulate matter only). The fugitive dust (PM_{10}) generated during construction would also contribute to visibility degradation. The NO_x and PM_{10} emission rates used in the visibility analyses are most likely overestimated, due to the conservative assumptions used to estimate them. Conservative assumptions that may affect emissions estimates (relevant to the visibility analysis), include:

- Steam/water separation during well head testing may be higher than estimated, leading to lower particulate matter missions
- PM_{10} emission estimates from well venting during construction and during plant operation do not take into consideration that much of the particulates entrained in steam would fall out as water droplets at the site
- Actual particulate and PM_{10} content of steam emitted may be conservatively high
- NO_x emissions from drill rigs are overestimated due to conservative loading factors used

VISCREEN Modeling: Impacts of project emissions on visibility at the closest Class I airshed, located at the Lava Beds National Monument and Wilderness Areas, were assessed using guidelines recommended by the EPA (EPA 1992). As noted at the beginning of this section, visibility impairment analyses are required only for projects subject to PSD permitting, which does not apply to the proposed project due to the low level of emissions. As there are two adjacent Class I areas within the sphere of possible impact from the project, a plume visibility analysis is provided in this section to provide for a conservative analysis of effects to these areas. The Class I areas are located within the two wilderness areas of the Lava Beds National Monument, as described in Section 3.13, Air Quality.

For single sources, impacts on visibility are assessed by evaluating the perceptibility of the emissions plume against a bright sky background and a dark terrain background. The EPA's VISCREEN model was used to perform this evaluation. There are three levels of visibility modeling that can be conducted for a proposed emission source. In

general, each level represents a progressively more refined visibility analysis of the potential impacts of a proposed source. The modeling conducted for this project is a Level-2 VISCREEN analysis.

VISCREEN evaluates plume perceptibility by estimating plume/background contrast at three light wavelengths, and then compares the overall brightness contrast and color difference (ΔE) to empirically-derived human perception thresholds. The thresholds used in the model as screening criteria have been developed with recognition of, and adjustment for, the fact that casual observers are less likely to notice a plume that they are not looking for.

VISCREEN, as its name implies, is a screening model. This means that it is intended to be relatively simple to use and require relatively simple input data, while quickly identifying those projects that would not cause visible plume impacts. The VISCREEN modeling overestimates the likely visibility impairment from the project due to the model's conservative assumptions (many of which do not apply to the proposed project) as described below under "Interpretation of Results."

Results of VISCREEN Modeling: The VISCREEN model output is provided in Appendix F, Attachment 1. The following scenarios for construction and operation were evaluated using Level-2 VISCREEN modeling:

- Worst-case scenarios for each of the three years of construction
- Normal operation
- A dual-turbine outage upset
- Normal operation while drilling an infill well

Construction: The model results show exceedances of visibility thresholds (which could indicate that a plume may be visible) both outside Lava Beds and within its boundaries during construction activities, including well drilling.

Operation: For the normal operation and the upset scenarios, the VISCREEN results indicated that the exceedances of visibility thresholds could only occur close to the source near the wellfield and power plant site, and not within Lava Beds.

Decommissioning: Decommissioning activities were not modeled using VISCREEN as no well drilling would occur during this phase of the project, which is the primary source of both NO_x and PM_{10}.

Interpretation of Results: Based on the raw model output alone, the impact of the emissions from the proposed project on visibility in the Lava Beds National Monument and Wilderness Areas would be considered a short-term, potentially significant impact during the construction period. However, a visible plume within the boundaries of the Lava Beds wilderness areas is unlikely to occur because:

- The emission rates for NO_x and PM_{10} overestimate the probable project emissions
- The conservative assumptions of the VISCREEN model, many of which do not apply to the proposed project, overestimate the likely visibility impairment from the project emissions
- Experience with similar development at other geothermal fields (Coso and The Geysers) indicates that visibility impairment has not occurred

The conservative assumptions of the VISCREEN model and experience with similar geothermal projects are described in more detail below.

VISCREEN Assumptions: The VISCREEN modeling results overestimate the likely visibility impairment from the project due to the model's conservative assumptions. As described below, many of the assumptions do not apply to the proposed project.

- The model assumes worst-case sun angles and viewing angles that may not be physically possible for the proposed project. The result is that the model calculations yield the brightest and the darkest possible plumes.
- The model assumes that the viewer's line of sight is directly horizontal (as if the plume were at eye level) so that it intersects the most plume material. In actuality, if a plume were visible from or within Lava Beds, it would be at least 800 feet above the ground and, therefore, the line-of-sight would not be horizontal.
- The VISCREEN treatment of plume dispersion results in an overestimation of the quantity of O_3 that would react with NO. This results in an overestimation of NO_2 and likely plume visibility.
- Multiple scatting of light, which typically occurs, is ignored in VISCREEN and would decrease the plume contrast.
- The model assumes the terrain is black and located as close to the observer and plume as possible. This assumption yields the darkest possible background against which plumes are likely to be most visible. For this project, the terrain would be less dark and would be located far from the observer (for most viewing angles). Additionally, a plume would probably never occur between a viewer in Lava Beds and terrain.
- The model cannot account for the site-specific complex terrain that exists for this project.

Additionally, the VISCREEN model does not provide information on the likely frequency of a potentially visible plume. However, based on available meteorological information, the wind blows in directions that would transport pollutants from the proposed wellfield and power plant site in the direction of Lava Beds about 30% of the time. If present, plumes would likely be more visible first thing in the morning before more favorable daytime dispersion conditions develop. .

More specific modeling results could be obtained by performing a Level-3 analysis using the PLUVUE II model. To perform this type of modeling, much more detailed meteorological and project information is required, much of which is not available for this project. Additionally, PLUVUE II has problems similar to those of VISCREEN regarding the use of conservative assumptions. PLUVUE II modeling for the project would be a significant expense. It is likely that the results of a PLUVUE II modeling effort would also overstate effects. Therefore, this type of modeling was not performed for this project.

Experience at Other Wellfields: Experience with drill rig operations in applications similar to the proposed project is not consistent with the VISCREEN results. Although diesel engines can produce visible smoke near the source when under heavy load or when operated improperly, plumes visible at considerable distances from the rigs have not been observed at similar projects in The Geysers KGRA, where geothermal operations have been on-going for many years. Likewise, at the Coso geothermal field in Inyo

County, California, visible plumes have not occurred, based on experience and observation in the field. The Coso geothermal field is located on the China Lake Naval Air Weapons Station where high visibility is critical to the station's management mission. Visible plumes were not present even with four drill rigs operating simultaneously in a single valley.

Mitigation Measures

Implementation of Mitigation Measure 4.13.1a would minimize PM_{10} emissions from earth work and other ground disturbing activities during construction. The mitigation measures below would minimize NO_x and PM_{10} emissions from drill rigs operation.

4.13.9a Calpine shall use diesel engines that have ignition timing retard to power drill rigs. Ignition timing retard refers to adjusting an engine's timing such that the fuel is injected into the cylinder later in the cycle, while the piston is traveling downward. This reduces NO_x emissions (by 20-30%) because the combustion takes place at a lower temperature, resulting in less conversion of nitrogen and oxygen present in the intake air to form nitric oxide (NO). It should be noted that the NO_x emissions modeled reflect control using ignition timing retard. (C, O)

Level of Significance After Mitigation

Potentially significant and unavoidable on a short-term basis.

4.13.10 Effect on Global Warming

Construction, operation, and decommissioning of the proposed project could potentially have an adverse but not significant impact on global warming.

This project would release CO_2 during well testing and power plant operation as CO_2 is a naturally-occurring constituent of geothermal fluids. As indicated in Section 3.13, CO_2 and other greenhouse gases may be leading to a global warming effect. Among power production technologies, geothermal energy systems have very low emissions of CO_2 compared to emissions from fossil fuel combustion. Typically, CO_2 emissions from geothermal energy systems are 9 to 17 percent of emissions from fossil fuel combustion, depending upon the fuel source (USFS et al. 1994). The CO_2 released by geothermal facilities comes from naturally-occurring subterranean sources and is not actually produced during the geothermal energy conversion or utilization processes.

Climatic changes and corresponding global impacts as a result of a significant warming of the earth's atmosphere would be difficult to estimate. It would also be difficult to predict the location and magnitude of the potential effects of greenhouse warming on a particular region. Global climate models currently used are sensitive to large-scale and seasonal changes only (USFS, BLM 1994). A possible scenario is that the arid regions of the western U.S. could become hotter and drier if global mean temperature were to increase by 3 degrees Celsius. Also, possible altered patterns of precipitation and evaporation could affect agriculturally productive areas. Such changes could produce detrimental or beneficial effects depending on geographical location.

It is not possible to accurately evaluate the impact of increased CO_2 emissions from this proposed project, or any individual project, because there is still significant scientific uncertainty concerning global climate change and its relationship to CO_2 emissions. For example, the relative importance of various greenhouse gases is an issue. While CO_2 is

the most abundant of the gases of concern, others are more efficient at absorbing heat. Also, deforestation is considered to be a major cause of adverse impacts on global warming trends. Although the areas of uncertainty are being addressed by on-going studies, the current state of scientific knowledge does not allow the impacts from CO_2 emissions from the proposed project to be understood. Geothermal energy production, however, has much less of an impact on potential global warming than fossil-fuel burning sources due to less CO_2 emissions. While the proposed project would contribute greenhouse gases to the atmosphere, this contribution is unlikely to be significant.

Mitigation Measures

No mitigation measures are recommended.

4.13.11 Conformity Analysis

All proposed federal actions must comply with the EPA rule on "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (40 CFR 93, Subpart B). This regulation requires that an analysis of the conformity of a proposed federal action be prepared in federal nonattainment or maintenance areas for each pollutant for which the project area is designated as a nonattainment or maintenance area, if the project emissions exceed thresholds listed in the regulation. The Northeast Plateau Air Basin is designated by the U.S. Environmental Protection Agency as attainment or unclassified for all pollutants, so a conformity analysis is not required for this project. The emissions estimates prepared for this document (see Appendix F), indicated that the emissions of all pollutants are expected to be below the thresholds listed in the regulation for nonattainment or maintenance areas, and would not be regionally significant. For this reason, no further analysis of conformity would be required even if the project was located in a nonattainment or maintenance area.

Mitigation Measures

No mitigation measures are required or recommended as no significant or adverse impacts would occur. Implementation of Mitigation Measure 4.13.1a would ensure that dust generation from project construction is minimized.

ALTERNATIVES

The effects of the alternatives would be similar as the air quality emissions are primarily from the wellfield and power plant and the siting and design of these facilities would be the same for all alternatives. The air quality effects of the alternatives would only be slightly different in the location of the fugitive dust emissions from construction of the alternative transmission line routes.

Alternatives 5 and 6, however, would avoid the Medicine Lake area, which would minimize PM_{10} emissions in this area. Alternatives 2, 4, and 6 would avoid the Tionesta area, which would minimize PM_{10} emissions near Tionesta. Alternative 6 would avoid both the Medicine Lake and the Tionesta areas and, therefore, no PM_{10} effects would occur in those locations. Alternative 7, the No Action Alternative, would avoid the air quality impacts of the proposed action (Alternative 1) and the other alternatives discussed in this section.

Alternative 2 (Segments A1, A2, B1, C2)

Transmission line construction would have similar short-term significant impacts on 24-hour ambient PM_{10} concentrations as segments A1, A2, and B1 would also be used for this alternative. PM_{10} concentrations at the Medicine Lake area receptors would therefore be similar to the proposed action. As segment C2 would go further north near the Dry Lake area, transmission line construction dust emission would be reduced in the Tionesta area, as compared to the proposed action.

As for the proposed action and the other alternatives, transmission line construction under this alternative would not result in significant impacts from PM_{10} emissions at any of the identified receptor locations. There could, however, be a potentially significant short-term, localized impact to air quality from transmission line construction in close proximity (within 250 feet) of the construction activities.

Alternative 3 (Segments A1, B2, C1)

Transmission line construction would have similar short-term significant impacts on 24-hour ambient PM_{10} concentrations as segments A1 and C1 would also be used for this alternative. PM_{10} concentrations at the Medicine Lake area and Tionesta receptors would therefore be similar to the proposed action. As segment B2 would not occur in proximity to adjacent receptor locations, no additional construction dust impacts would occur with this alternative related to the use of segment B2.

As for the proposed action and the other alternatives, transmission line construction under this alternative would not result in significant impacts from PM_{10} emissions at any of the identified receptor locations. There could, however, be a potentially significant short-term, localized impact to air quality from transmission line construction in close proximity (within 250 feet) of the construction activities.

Alternative 4 (Segments A1, B2, C2)

Transmission line construction would have similar short-term significant impacts on 24-hour ambient PM_{10} concentrations as the proposed action in the Medicine Lake area, as segment A1 would also be used for this alternative. As for Alternative 2, this alternative would use segment C2. As segment C2 would go further north near the Dry Lake area, transmission line construction dust emissions would be reduced in the Tionesta area, as compared to the proposed project.

As for the proposed action and the other alternatives, transmission line construction under this alternative would not result in significant impacts from PM_{10} emissions at any of the identified receptor locations. There could, however, be a potentially significant short-term, localized impact to air quality from transmission line construction in close proximity (within 250 feet) of the construction activities.

Alternative 5 (Segments A3, B1, C1)

Transmission line construction would have similar short-term significant impacts on 24-hour ambient PM_{10} concentrations as segments B1 and C1 would also be used for this alternative. PM_{10} concentrations at the Medicine Lake area receptors would be less than the proposed action, as segment A3 would avoid the Medicine Lake area.

As for the proposed action and the other alternatives, transmission line construction under this alternative would not result in significant impacts from PM_{10} emissions at any of the identified receptor locations. There could, however, be a potentially significant short-term, localized impact to air quality from transmission line construction in close proximity (within 250 feet) of the construction activities.

Alternative 6 (Segments A3, B1, C2)

Transmission line construction would have similar short-term significant impacts on 24-hour ambient PM_{10} concentrations as segments B1 and C1 would also be used for this alternative. PM_{10} concentrations at the Tionesta receptor would be less than the proposed action, as segment C2 would be further to the north than segment C1. PM_{10} concentrations at the Medicine Lake area receptors would be less than the proposed project, as segment A3 would avoid the Medicine Lake area.

As for the proposed action and the other alternatives, transmission line construction under this alternative would not result in significant impacts from PM_{10} emissions at any of the identified receptor locations. There could, however, be a potentially significant short-term, localized impact to air quality from transmission line construction in close proximity (within 250 feet) of the construction activities.

Alternative 7 (No Action)

Alternative 7, the No Action alternative would not result in air quality effects at any of the sensitive receptor locations or elsewhere.

4.14 Noise

INTRODUCTION

This section addresses the noise sources and effects of the proposed action and alternatives. The effects on forest visitors, the Medicine Lake area, and the community of Tionesta are addressed in this section. Noise effects that may be experienced at traditional cultural sites by American Indians are addressed in Section 4.6, Traditional Cultural Values, specifically impact 4.6.3. Noise effects on wildlife are addressed in Section 4.8, Wildlife.

KEY ISSUES

The key noise issues identified and evaluated in this section relate to construction noise effects of the proposed project in both the Medicine Lake area and the community of Tionesta. These effects are evaluated in Impacts 4.14.2 and 4.14.3, respectively. Another key noise issue relates to operational noise in the Medicine Lake area, which is evaluated in Impact 4.14.2.

REGULATORY FRAMEWORK

Federal guidance for addressing noise effects from geothermal operations are contained in Geothermal Resource Operational Order (GRO) No. 4 (USGS 1980). This GRO states that, in the absence of more restrictive criteria, noise at 0.5 mile from major geothermal operations shall not exceed 65 dBA. This level on a 24-hour basis is equivalent to approximately L_{dn} 71. The nearest receptors are the three homes north of Little Medicine Lake which are about 2.2 miles southeast of the proposed wellfield and power plant site. There are no other Federal noise standards or LRMP policies that are used by the Klamath and Modoc National Forests in addressing and evaluating noise.

The proposed power plant and well pads and a portion of the proposed transmission line would be located in Siskiyou County. The Noise Element of the Siskiyou County General Plan (Siskiyou County 1978) identifies and evaluates the compatibility of land uses with various exterior noise levels. In doing so, the element provides direction for the appropriate siting of land uses so that incompatibilities related to noise generation do not occur. However, the Noise Element does not specifically regulate geothermal noise. The Noise Element identifies a maximum noise level of 60 dBA L_{dn} for parks, playgrounds, and residential uses and a maximum noise level of 50 dBA L_{dn} for passively-used open space (quiet or contemplation areas of public parks). The 60 L_{dn} limit probably best fits the majority of recreational uses around Medicine Lake: fishing, hunting, snowmobiling, etc. As Siskiyou County does not have jurisdiction over National Forest lands, the Siskiyou County noise compatibility standards do not apply to these Federal lands.

The remaining portion of the proposed transmission line and the substation would be located in Modoc County. The Noise Element of the Modoc County General Plan (Modoc County 1988) identifies a maximum noise level of 60 dBA L_{dn} for residential uses and 70 dBA L_{dn} for active recreation areas such as water recreation areas, golf courses, riding stables, etc. As with Siskiyou County, Modoc County does not have

jurisdiction over National Forest lands. The County noise compatibility standards therefore do not apply to these Federal lands.

METHODOLOGY

Expected noise levels from well drilling and geothermal operations are based on noise measured at other existing geothermal energy operations, including The Geysers (G.S. Nolte & Associates 1986) in Lake County, California and Coso KGRA (MHA 1988) in Inyo County, California. Based on these expected noise levels, a mathematical noise model was then applied to determine projected noise levels at identified receptor locations with implementation of the proposed action. The results of this modeling are presented in impacts 4.14-2 and 4.14-3.

In developing the model, the *"Power Plant Noise Guide"* (Edison Electric Institute 1984) was reviewed for relevant variables and techniques for estimating noise levels from power plant operations. These guidelines indicate that sound propagation over large distances is affected by the distance between noise source and noise receptor, and both hemispherical spreading and molecular absorption of the sound. The height and location of terrain between a noise source and a receiver that may function as a noise barrier is also accounted for in the calculations.

The mathematical model of sound propagation also permits an estimate of the expected noise increase if atmospheric conditions (wind direction or a thermal inversion) are conducive to transmitting sound toward a receptor. These conditions may circumvent noise reductions due to terrain functioning as a noise barrier. How often or when such conditions may occur for the proposed project is not precisely known, but estimates of possible noise increases suggest the possible range of noise exposures at some locations.

Additionally, forest noise levels at various distances from the wellfield and power plant site and the transmission line were determined. This was accomplished using a straight line analysis, based on typical noise attenuation with distance from a source (6 dBA noise decrease with each doubling of distance). The resulting project noise levels presented in Impact 4.14-1 do not account for additional noise attenuation that would occur with terrain and forest cover and therefore likely overestimate project noise levels.

SIGNIFICANCE CRITERIA

In accordance with NEPA and CEQA guidelines, significant noise impacts would be expected to occur if:

- The project would generate noise levels that would conflict with local noise regulation
- Project operations substantially increase noise levels in areas of sensitive receptors
- The land uses proposed by the project are not compatible with ambient noise levels

Additionally, construction noise impacts of the project would be considered significant if:

- Construction activities would affect noise-sensitive receptors
- Expected noise levels would endanger the hearing of receptors near the construction site

- Construction activities would affect receptors during noise sensitive periods, at night for example

As discussed above, GRO No. 4 states that noise levels from a geothermal operation at 0.5 mile from the operation or at the lease boundary (whichever is greater), shall not exceed 65 dBA (USGS 1980). This Federal GRO regulation was used in evaluating the impacts of construction and operation of the proposed wellfield and power plant. This regulation was not used in evaluating the impacts of construction and operation of the proposed transmission line as it applies only to geothermal operations.

The Siskiyou and Modoc County Noise Elements noise compatibility standards were used to assess noise impacts from the project on both private and public lands within the Klamath and Modoc National Forests. As noted above, these county noise compatibility standards do not apply to Federal lands. These standards, however, are used in this EIS/EIR document as the basis for evaluating impact significance under CEQA.

The Siskiyou County noise compatibility standard is 54 dBA L_{eq}, based on a L_{dn} of 60 dBA. In Modoc County, the noise compatibility standard is also 54 dBA L_{eq}, based on a L_{dn} of 60 dBA. These limits would be compared to projected noise levels at identified receptors. Typically, noise compatibility standards are not used to evaluate or regulate construction noise as such noise does not result in long-term incompatibilities between land uses. For the purposes of providing a conservative analysis, project construction noise was compared to these standards at receptor locations as the basis for evaluating impact significance under CEQA.

PROJECT NOISE SOURCES AND ASSUMPTIONS

Construction

Wellfield and Power Plant: Wellfield and power plant construction may require up to 18 months, depending upon when it begins and whether the outer shell of the power plant is completed prior to the onset of winter. The initial well drilling activities are expected to occur for six-month periods in three consecutive years.

Estimates of noise levels from construction of a typical well pad or the power plant assumed an equipment assemblage which included one large bulldozer, one scraper, a large diesel truck, and one cement truck or crane. It was also assumed that, on average, each piece of equipment would generate a maximum noise level of about 83 dBA at a distance of 50 feet one-half of the time and would operate at idle the other half. Construction will occur between the hours of 7:00 a.m. and 10:00 p.m. due to the short construction period in the Highland.

The drilling rig is assumed to be diesel-electric powered, using bentonite-based muds and three diesel-powered engines. Drilling any well is assumed to require 25 to 90 days. Well venting and testing are assumed to be infrequent and limited in duration but may be as long as 90 days. During testing, it is assumed that the wells will not be vented directly to the atmosphere. Calpine has stated that they would use a separator/muffler to reduce noise levels. Well drilling and venting are 24-hour operations. In addition, it is assumed that drilling noise is at an elevation of 40 feet above the local ground, or well pad elevation.

Transmission Line: Construction of the power transmission line is expected to occur during two consecutive years. During the first year, the clearing and road construction crews would progress about six miles per day and thus should be near any given receptor for only several hours. Of greater importance with respect to noise effects is the period during the second construction season when pole erection and wire stringing would occur. During this period, five crews would be in an area for approximately one week. The crews are (1) assembly, (2) erection, (3) counterpoise, (4) conductor stringing, and (5) clean-up. These crews would travel along the transmission line corridor and work sequentially at the transmission tower sites. It is also assumed that different crews would be working concurrently at adjacent sites.

Evaluation of transmission line construction noise is based on construction activities at the three transmission towers that would be nearest to any noise receptor. Noise levels should be the highest when work is in progress at these three towers. The distance between the first and third towers would be approximately 1,400 feet, with the second tower midway between the other two and nearest to a receptor. In addition, the analysis assumes that, at the distances between the towers and receptors (roughly 1,200 feet at the North Campgrounds and about 4,200 feet to the homes at the southeast end of Medicine Lake), terrain does not function as a significant noise barrier. The equipment ensemble used by each crew is assumed to produce a noise level of 86 dBA at a distance of 50 feet from the center of activity.

Operation

The analysis of noise expected from power plant operation assumes a ten-cell cooling tower system, each tower containing a 200-horsepower (150 kilowatt) electric motor, a 37 MVA transformer, and a turbine-generator building. Cooling tower height is at 62 feet above ground level, which is the elevation of the fans, and building noise is assumed to be centered at an elevation of 60 feet above ground.

The turbine-generator building is assumed to contain much noise-generating equipment, such as an air compressor, air scrubbing system, de-misters, and numerous pumps. Average noise levels of 85 dBA inside this building are assumed in order for employee noise exposures to comply with Occupational Health and Safety Act (OSHA) noise limits. The building would be designed to accommodate cold temperatures (down to -40°F) and thus, is expected to be well-insulated thermally and acoustically with noise absorptive interior walls. Building walls are assumed to have noise reduction properties similar to that of 22-gauge steel.

In-fill well drilling during operation would use similar drilling techniques as identified above for well drilling during construction.

Decommissioning

As decommissioning activities would use similar equipment to that described above for construction at the wellfield and power plant site and along the transmission line, noise levels would be similar to those identified above for these sites.

PROPOSED ACTION (ALTERNATIVE 1)

The impact evaluation provided below addresses the overall effects of the proposed action on ambient noise levels throughout the forest (Section 4.14.1), as well as the effects on noise levels at identified sensitive receptor locations, including Medicine Lake (Section 4.14.2) and Tionesta (Section 4.14.3). Effects are evaluated for construction, operation, and decommissioning of the proposed action. The project noise levels are compared to ambient conditions throughout the impact evaluation.

4.14.1 Effects on Forest Noise Levels

The project impact on forest noise levels from project construction, operation, and decommissioning could result in short-term significant impacts to forest users that come in close proximity to the wellfield and power plant site, or to the transmission line. Please refer to Sections 4.14.2 and 4.14.3 for information about noise levels at sensitive receptors in the Medicine Lake area and in Tionesta.

Construction: Noise levels at various distances from project construction activities were estimated using a straight line analysis. This analysis was based on the typical noise level decrease that would occur with distance (6 dBA for each doubling of distance from the noise source). For example, transmission line construction noise levels of 86 dBA at a distance of 50 feet would decrease 6 dBA for each doubling of distance beyond 50 feet. Noise levels herein are intended to represent the worst-case. These noise levels do not take into account the noise attenuation that could result from specific terrain and vegetation features present in a given location.

A forest visitor driving past the wellfield and power plant site (on Primary Forest Route 49 approximately 850 feet from the site) during power plant and wellfield construction, including well drilling, would likely hear noise levels of approximately 62 dBA. A hiker or hunter passing in close proximity (between 200 to 400 feet away) to the wellfield and power plant site during construction would hear higher noise levels, ranging from 74 to 68 dBA, respectively, depending upon the actual distance from the sites. Noise from steady drilling sounds like a low-frequency hum or a "rushing" sound. These sounds are not expected to be particularly annoying to people. The clanging of drill pipes and high-pressure air releases are expected to be audible and possibly annoying to forest users, depending upon their location. Similar noise levels would be heard by a hiker or hunter passing in proximity to the transmission line during construction.

Construction noise associated with wellfield, power plant, and transmission line construction could result in short-term significant impacts if users of forest lands are exposed to construction noise in excess of the Siskiyou and Modoc County noise compatibility standard of 54 dBA L_{eq} (60 L_{dn}). An exceedance of this standard could occur within approximately 2,100 feet of the construction sites. Construction activities, however, would not exceed the GRO noise limit as modeled and evaluated in Impact 4.14.2, below. Typical forest visitors (hikers and hunters) that may come in close proximity to the wellfield and power plants site, and the transmission line would mostly be in these areas for relatively brief periods of time and therefore would be exposed to construction noise on a temporary basis. Additionally, noise levels during construction would not endanger the hearing of forest visitors in these areas, nor would they occur during noise sensitive periods such as night.

Operation: Noise levels at various distances from project operation activities were estimated using the same straight line analysis described above for construction. Operational noise levels provided below therefore are conservatively high as they do not take into account the noise attenuation that would result with specific terrain and vegetation features.

A forest visitor driving past the wellfield and power plant site on Primary Forest Route 49 during operation would likely hear noise levels of approximately 66 dBA, at approximately 850 feet from the site. A hiker or hunter passing in close proximity (200 to 400 feet) to the wellfield and power plant site during operation would hear higher noise levels, ranging from 78 to 72 dBA, depending upon the actual distance from the site.

Noise associated with wellfield and power plant operation could result in significant impacts if users of forest lands are exposed to operational noise in excess of the Siskiyou County noise compatibility standard of 54 dBA L_{eq} (60 L_{dn}). An exceedance of this standard could occur within approximately 3,200 feet of the wellfield and power plant site. Operation activities would not, however, exceed the GRO noise limit as modeled and evaluated in Impact 4.14.2, below. Typical forest visitors (hikers and hunters) that may come in close proximity to the wellfield and power plants site would mostly be in these areas for relatively brief periods of time and therefore would be exposed to operational noise on a temporary basis. Additionally, noise levels during operation would not endanger the hearing of forest visitors in these areas, nor would they occur during noise sensitive periods such as night.

Operation of the proposed transmission line would not result in the generation of noise and therefore would not impact ambient noise levels in the forest. Routine maintenance activities, expected to occur twice a year, could produce temporary noise increases, likely to be much lower than construction noise levels. The occasional presence of vehicles and equipment to repair downed wires, damaged towers, or other facilities (associated with snow, wind, and other conditions) could also be present along the transmission line. Noise levels from such activities would likely be less than for construction, but could result in adverse effects on forest visitors using areas in close proximity to such line repairs.

Decommissioning: Project noise levels during decommissioning of the wellfield and power plant facilities and transmission line facilities, would be similar to those described above for construction, as similar equipment would be used. As for the construction phase, a short-term significant impact could occur if visitors are exposed to noise levels above Siskiyou and Modoc County noise compatibility standards. Decommissioning activities, however, would not exceed the GRO noise limit. Typical forest visitors that may come in close proximity to the wellfield and power plants site, and the transmission line would mostly be in these areas for relatively brief periods of time and therefore would be exposed to decommissioning noise on a temporary basis. Additionally, noise levels during decommissioning would not endanger the hearing of receptors in this area, nor would they occur during noise sensitive periods such as night.

Mitigation Measures

Impacts on forest noise levels from the project could be short-term significant if visitors are exposed to noise levels above county noise compatibility standards. Mitigation Measures 4.14.2a through 4.14.2c, designed to reduce noise effects on sensitive receptors in the Medicine Lake and Tionesta areas, would also reduce the forest noise levels in close proximity to the proposed wellfield and power plant site and along the transmission line.

Level of Significance After Mitigation

Significant unavoidable impact if visitors are exposed to noise levels above county noise compatibility standards.

4.14.2 Noise Effects on Sensitive Receptors Near Medicine Lake

Construction and decommissioning activities for the proposed project could result in short-term noise increases in the Medicine Lake area. Impacts on certain Medicine Lake area sensitive receptors from these increased noise levels during construction and decommissioning would be significant during transmission line construction in proximity to these receptors. Operation of the proposed project would not result in significant or adverse noise impacts on Medicine Lake area sensitive receptors.

Construction: It is anticipated that the period of highest construction noise would occur during the summer of the second construction season, when the following construction activities would occur concurrently:

- Well pad and power plant construction
- Well drilling and testing
- Transmission line pole erection and wire stringing

The following discussion provides an evaluation of worst-case construction noise during concurrent construction activities. Wellfield and power plant construction and well drilling are also evaluated.

Concurrent Construction: Table 4.14-1 provides estimated sound levels at Medicine Lake receptors from construction activities. The table provides noise levels for each construction activity (wellfield, power plant, and transmission line), as well as total noise levels for concurrent construction activities. The total noise levels identified in this table would occur only during construction of the three transmission towers nearest the Medicine Lake noise receptors.

Construction of the three towers nearest to the Medicine Lake receptors is anticipated to last for less than a week. During this time, concurrent construction activities would result in a total noise level of 62 dBA L_{eq} at Site 1 (north campgrounds at Medicine Lake) and 57 dBA L_{eq} at Sites 3 through 5 (Little Medicine Lake area sites), which would exceed the 54 dBA L_{eq} (60 L_{dn}) noise compatibility standard identified in the Siskiyou County Noise Element. Concurrent construction activities would result in noise levels below this limit at Site 2 (homes at southeastern side of Medicine Lake). Noise levels would be lower for all other construction periods.

Table 4.14-1: Estimated Sound Levels from Construction[1] at Selected Receptor Locations

Location of Receptor		Ambient Noise	Construction Noise (dBA L_{eq})			
			2 Wells	Power Plant	Transmission Line[2]	Total Level
1.	North campgrounds	37.0	40	37	62	62.0
2.	Homes at southeast end of Medicine Lake	35.8	38	35	52	52.3
3-5.	Little Medicine Lake area receptors	33.0	41	38	57	57.2

Notes:

1 Wellfield and power plant construction noise levels do not include any noise reductions due to terrain acting as noise barriers; thus, they are to be considered as worst cases. Little, if any noise reduction due to terrain is expected during power line construction.

2 Noise levels associated with concurrent construction at the three tower sites nearest each receptor.

SOURCE: Consultants in Engineering Acoustics 1996

Helicopters would be used during construction for stringing conductors along the transmission line route and during routine maintenance checks. The Bell Jet Ranger, a helicopter commonly used during transmission line construction, produced noise levels of 76 to 85 dBA when the helicopter was 200 to 300 feet overhead at the receptor site (NWC 1986). The noise levels are similar to those created by other typical construction noise sources.

Wellfield and Power Plant Construction: Once transmission line construction has passed through the Medicine Lake area, construction noise levels at these sensitive receptor sites would be related only to wellfield and power plant construction activities. As shown in Table 4.14.1, construction noise levels from these activities would be significantly lower than the total construction noise levels that would occur when transmission line construction takes place in proximity to these receptor locations. Noise levels from well pad and power plant construction would not exceed the 54 dBA L_{eq} (60 L_{dn}) noise limit identified in the Siskiyou County Noise Element.

Additionally, wellfield and power plant construction would not exceed the GRO Order No. 4 noise limit, which requires that sound levels from geothermal operations not exceed 65 dBA at a distance of 0.5 mile. Extrapolating the total noise level of 86 dBA at 50 feet to a distance of 0.5 mile results in an average noise level of about 51 dBA at this distance. If two well pads in near proximity to each other are constructed simultaneously, or if the power plant and a nearby well pad are constructed simultaneously, the resulting total noise level is expected to be about 54 dBA at this

distance. Thus, well pad or power plant construction noise would not exceed the GRO Order No. 4 limit.

Well Drilling: Due to the nature of well drilling noise, it is more likely to be audible and potentially annoying than the other construction noise sources. Well drilling noise at the various receptors, when two wells are drilled, is estimated to be in the 20 to 26 dBA range which is significantly lower than the 54 dBA L_{eq} (60 L_{dn}) limit from the Siskiyou County Noise Element and below ambient noise levels (see Table 3.14-2 in Section 3.14). However, an evaluation of octave band noise levels from drilling was conducted to determine whether such noise could be audible and potentially annoying.

Table 4.14-2 shows the octave band noise levels, in dB, and the overall noise levels in dBA, estimated if wells at pads P-1 and P-2 are drilled and vented simultaneously. These wells were selected because they are at the highest elevations and, thus, are least likely to be affected by terrain. Noise barrier effects associated with terrain reduced the sound levels at all receptor locations but the reductions were least for these two wells.

As indicated in Table 4.14-2, estimated octave band noise levels during well drilling activities would not produce audible sounds in the 1,000 (1 Khz, or kilohertz) to 8,000 (8 Khz) bands, which are the frequencies that the human ear is most sensitive to. This occurs because the air molecules absorb (much like a sponge absorbs water) most of the acoustical energy at these frequencies.

Comparing these octave band levels to ambient levels shown in Table 3.14-3, illustrates that the estimated octave band levels from drilling noise are almost uniformly lower than or just about equal to the ambient levels. Moreover, the octave bands of drilling noise do not show any "peaks," i.e. bands which are 5 to 10 dB higher than the two adjacent bands. Thus, it appears unlikely that people near Little Medicine Lake and Medicine Lake would usually be able to hear drilling noises.

Construction Impact Conclusion: Noise generated during project construction would result in a short-term significant impact during transmission line construction in proximity to the Medicine Lake receptors. As construction activities would not, however, exceed County noise standards for more than a week, this significant impact would occur only on a short-term basis. Noise levels during construction would not endanger the hearing of receptors in this area, nor would they occur during noise sensitive periods such as night.

Operation: During operations, the primary source of noise from the proposed action would be the power plant; however, approximately every two years infill wells would be drilled at the proposed well pads. Infill well drilling would last from 25 to 90 days. Once the wells are drilled, they generally produce relatively little noise. Moreover, because of the need to maintain resource temperatures, the well pad equipment and pipelines are expected to be wrapped in at least 3 inches of thermal insulation with a protective coating, or sleeve, around the insulation. This wrapping is expected to further reduce the already low levels of well pad and pipeline noise.

Table 4.14-2: Estimated Sound Levels from Well Drilling at Selected Receptor Locations[1]

Location of Receptor	Octave Band Center Frequency (in dB)								Overall in dBA L_{eq}
	63 Hz	125 Hz	250 Hz	500 Hz	1 Khz	2 Khz	4 Khz	8 Khz	
1. North Campgrounds	41	39	27	8	0	0	0	0	25
2. Homes at southeast end of Medicine Lake	39	36	25	5	0	0	0	0	22
3. Homes and picnic area near Little Medicine Lake	40	36	25	6	0	0	0	0	22
4. Schonchin Picnic Area[2]	42	40	29	11	0	0	0	0	26
5. Home at southwest end of Medicine Lake[2]	38	34	22	2	0	0	0	0	20

Notes:

[1] Estimated sound levels are for drilling wells at pads P-1 and P-2.

[2] Octave band frequencies are also provided for the Schonchin picnic area, just north of Little Medicine Lake, and for the home at the southwest end of Medicine Lake. This information is based on ambient noise levels and octave band levels as measured at receptor site 3, near Little Medicine Lake, which are representative of these other two locations.

SOURCE: Consultants in Engineering Acoustics 1996

Drilling of two wells simultaneously with power plant operation would result in the highest operational noise levels that would occur at any of the receptor locations. Table 4.14-3 summarizes the noise levels expected if the two wells located at the highest elevations are being drilled when the power plant is in full operation. The highest noise level, in the Schonchin picnic area (Site 4), is estimated to be about 27 dBA L_{eq}, which would not exceed the 54 dBA L_{eq} (60 L_{dn}) noise compatibility standard, identified in the Siskiyou County Noise Element. This table shows that the relatively short-term (30 days) drilling noise is consistently higher than power plant operational noise. When the two potential noise sources occur concurrently, the noise level is not increased appreciably over the level that would occur with drilling alone. Power plant noise does not add much to the dominant and much louder drilling noise. Power plant operation noise levels without in-fill well drilling activities at noise-sensitive receptor locations are shown in Table 4.14-4. These levels also would not exceed the 54 dBA L_{eq} (60 L_{dn}) noise compatibility standard, identified in the Siskiyou County Noise Element. Both of the project operational conditions described above would not result in noise levels that would exceed the Federal GRO No. 4 noise limit of 65 dBA at 0.5 miles from the site.

Table 4.14-3: Estimated Sound Levels from Well Drilling and Power Plant Operations at Selected Receptor Locations

Location of Receptor	Ambient Noise (dBA L_{eq})	Operation Noise (dBA L_{eq})		
		Well Drilling[1]	Power Plant Operations	Total Level
1. North Campgrounds	37.0	25	13	25.3
2. Homes at southeast end of Medicine Lake	35.8	22	11	22.3
3. Homes and picnic area near Little Medicine Lake	33.0	22	16	23.0
4. Schonchin Picnic Area[2]	33.0	26	18	26.6
5. Home at southwest end of Medicine Lake[2]	33.0	20	13	20.8

Notes:

[1] Estimated sound levels are for drilling wells at pads P-1 and P-2.

[2] The ambient noise levels presented for Sites 4 and 5 are based on measurements taken at Site 3, which are considered to be representative of these other sites.

SOURCE: Consultants in Engineering Acoustics 1996

Table 4.14-4: Estimated Sound Levels from Power Plant Operations at Selected Receptor Locations

Location of Receptor	Octave Band Center Frequency (in dB)								Overall in dBA L_{eq}
	63 Hz	125 Hz	250 Hz	500 Hz	1 Khz	2 Khz	4 Khz	8 Khz	
1. North Campgrounds	30	26	17	7	0	0	0	0	13
2. Homes at southeast end of Medicine Lake	29	24	15	3	0	0	0	0	11
3. Homes and picnic area near Little Medicine Lake	32	28	20	10	0	0	0	0	16
4. Schonchin Picnic Area	33	30	22	13	0	0	0	0	18
5. Home at southwest end of Medicine Lake	30	26	17	6	0	0	0	0	13

SOURCE: Consultants in Engineering Acoustics 1996

The overall noise level from power plant and in-fill well drilling operations would not be expected to increase significantly at receptor locations under atmospheric conditions conducive to sound transmission toward the noise receptors; the noise may be detectable at times. Table 4.14-3 shows that the average ambient noise level is 33 dBA (L_{eq}) at the homes and picnic area near Little Medicine Lake (Site 3), which is the quietest of the three measurement sites. Under certain conditions, such as when a thermal inversion occurs or prevailing winds are to the southeast, power plant sounds may become audible at that location. When such conditions occur, the average overall sound level is estimated to be about 30 dBA, or about 3 dBA less than ambient. However, the ambient L_{90} level (see Table 3.14-2) is expected to be about 25 dBA, so that a 30 dBA level may be detectable.

Operation of the proposed transmission line would not result in the generation of noise and therefore would not impact ambient noise levels in the Medicine Lake area. Routine maintenance activities, expected to occur twice a year, could produce temporary noise increases, likely to be much lower than construction noise levels. The occasional presence of vehicles and equipment to repair downed wires, damaged towers, or other facilities (associated with snow, wind, and other conditions) could also be present along the transmission line. Noise levels from such activities would likely be less than for construction, but could result in adverse effects on Medicine Lake visitors using areas in close proximity to such line repairs.

Operational Impact Conclusion: Although potentially detectable at times, operational noise would not be considered a significant impact as the Siskiyou County noise compatibility standard and the GRO No. 4 noise limit would not be exceeded. Moreover, power plant noise and noise from the cooling tower, in particular, are not expected to contain any prominent tones. Thus, it may be difficult for people to determine what is being heard and what the source of the noise may be. Operation noise is therefore considered to be a less-than-significant impact.

Decommissioning Effects: The noise effects of decommissioning the proposed facilities is expected to be less than noise levels and associated effects identified for construction of the proposed facilities because well drilling would not occur. The length of time required for decommissioning is also expected to be similar to the construction period. As for construction, this effect would be a short-term significant impact during transmission line decommissioning in close proximity to the Medicine Lake receptors.

Mitigation Measures

Noise impacts to sensitive receptors near Medicine Lake would be significant during construction and decommissioning of the transmission line in proximity to the Medicine Lake area receptors. Mitigation Measures 4.11-1a and 4.12.3a (see Sections 4.11 and 4.12) would help to minimize significant impacts to sensitive receptors. In addition, implementation of the following mitigation measures would further reduce effects of construction and decommissioning noise at these sensitive receptors.

4.14.2a Calpine shall use feasible noise controls on standard construction equipment to minimize potential noise effects to existing nearby residences. Impact tools should be shielded or shrouded when practicable, and equipment should have a muffled exhaust. (C, O, D)

4.14.2b For the portion of segment A1 located within the Modoc National Forest, Calpine shall not perform transmission line construction activities on Sundays and legal holidays or between the hours of 10:00 p.m. and 7:00 a.m. (C)

4.14.2c Calpine or its contractors shall implement site-specific measures to respond to complaints and minimize future disturbances of nearby residences. Such measures could include changing the location of stationary equipment, installing acoustic barriers around stationary construction noise sources, shutting off idling equipment, and rescheduling construction activity. (C)

Level of Significance After Mitigation

Significant unavoidable impact on a short-term basis during construction and decommissioning of the transmission line in proximity to the Medicine Lake area receptors.

4.14.3 Noise Effects on Sensitive Receptors Near Tionesta

The noise effects on sensitive receptors near the community of Tionesta would be associated with initial construction of the transmission line and subsequent decommissioning of the line. These effects would be considered a significant impact as project noise levels would exceed Modoc County noise standards during transmission line construction in proximity to these receptors. Project operation would not result in any noise effects on the community.

Construction Effects: Transmission line construction at the three transmission line towers closest to Tionesta would last for less than a week. During this time it is expected that transmission line construction noise would audible at both the nearest and the more distant residences. The nearest residence in Tionesta appears to be about 1,500 feet from the transmission line. If three transmission towers are built at this nearest line location, the noise level at that residence is estimated to be about 61 dBA. This noise level would exceed the 54 dBA L_{eq} (60 L_{dn}) noise compatibility standard identified in the Modoc County Noise Element. Construction noise would be about 57 dBA at the Tionesta residences that are the farthest from the nearest line location; this level would also exceed the Modoc County noise compatibility standard. Some residences may find construction noise annoying as such noise would be at least 10 dB above ambient (this level is such that it could result in complaints) (ISO 1971).

Helicopters would be used during construction for stringing conductors along the transmission line and during routine maintenance checks.

Helicopter noise would be most apparent and loudest at residences nearest to on-going construction. Helicopter noise would likely be loudest in Tionesta when transmission line construction would be occurring in close proximity to the community.

Noise generated during project construction would result in a short-term significant impact during transmission line construction in proximity to the community of Tionesta. This impact would not be considered short term because construction activities would not exceed noise standards for more than a week. Additionally, noise levels during construction would not endanger the hearing of receptors in this area, nor would they occur during noise sensitive periods (night).

Operational Effects: Operation of the wellfield and power plant would not generate noise that could be heard in the community of Tionesta, which is approximately 23

miles east of the plant site. Operation of the proposed transmission line, approximately 1,500 feet north of the nearest residence in the community of Tionesta, would not result in the generation of noise or noise-related activities in the Tionesta area. Routine maintenance activities, expected to occur twice a year, could produce temporary noise increases, likely to be much lower than construction noise levels. The occasional presence of vehicles and equipment to repair downed wires, damaged towers, or other facilities (associated with snow, wind, and other conditions) could also be present along the transmission line. If transmission line repairs occur in close proximity to the Tionesta residences, the impacts of increased noise levels could be adverse, but would not be significant.

Decommissioning Effects: The noise effects of decommissioning of the proposed transmission line is expected to be similar to noise levels and associated effects identified for construction of the proposed facilities. Additionally, the length of time required for decommissioning is also expected to be similar to the construction period. As for construction, this effect would be a short-term significant impact during transmission line decommissioning in close proximity to the community of Tionesta.

Mitigation Measures

Noise impacts to sensitive receptors near Tionesta would be significant during construction and decommissioning of the transmission line in proximity to the Tionesta receptors. Implementation of Mitigation Measures 4.11.1a, 4.12.3a, 4.14.2a, and 4.14.2c, above, would reduce the short-term effects of construction and decommissioning noise in the community of Tionesta. In addition, the following mitigation measure is recommended.

4.14.3a For the portion of segment C1 located east of the PacifiCorp and USWAPA 500 kV corridor and west of Highway 139, Calpine shall not perform transmission line construction activities on Sundays and legal holidays or between the hours of 10:00 p.m. and 7:00 a.m. (C)

Level of Significance After Mitigation

Significant and unavoidable impact on a short-term basis during construction and decommissioning of the transmission line in proximity to the Tionesta receptors.

ALTERNATIVES

The following subsections provide a comparative analysis of the alternatives related to noise effects of the proposed action. Overall, Alternative 6 would result in the least noise-related effects as compared to the proposed route (Alternative 1) and the other route alternatives, as Alternative 6 would avoid both the Medicine Lake area and the community of Tionesta. Alternative 7, the No Action Alternative would result in no noise effects.

Alternative 2 (Segments A1, A2, B1, C2)

Effects on Forest Noise Levels: The project effect on forest noise levels would be the same as described for the proposed action as it relates to the construction, operation, and decommissioning of the wellfield and power plant. Transmission line construction and decommissioning would have similar short-term significant impacts on forest noise levels as the proposed action as segments A1, A2, and B1 would also be used for this

alternative. As segment C2 would go further north near the Dry Lake area, transmission line construction and decommissioning noise would also result in short-term significant noise impacts in the Dry Lake area. A discussion of the changes in noise effects on the community of Tionesta with this alternative is provided below.

Effects on Sensitive Receptors Near Medicine Lake: The noise effects on sensitive receptors near Medicine Lake, under Alternative 2, would be the same as for the proposed action, as the wellfield and power plant would occur on the same site and the transmission line route would follow segment A1, passing just north of Medicine Lake. Therefore, as for the proposed action, construction and decommissioning would result in short-term significant impacts on Medicine Lake receptors. Implementation of Mitigation Measures 4.14-2a through 4.14-2c would minimize these effects, but they would remain significant and unavoidable on a short-term basis.

Effects on Sensitive Receptors Near Tionesta: The noise effects on sensitive receptors near Tionesta, under Alternative 2, would be less than for the proposed action, as the transmission line route under this alternative would follow segment C2, which passes approximately 3 miles further north than segment C1. Initial construction and subsequent decommissioning activities for the transmission line along segment C2 would not be heard at residences in the Tionesta area as construction noise levels in this area would be no more than 36 dBA, which is comparable to ambient conditions. Therefore, no short-term significant impacts would occur with transmission line construction and decommissioning, and Mitigation Measures 4.14.2a through 4.14.2c and 4.14.3a would not be necessary for this alternative.

Alternative 3 (Segments A1, B2, C1)

Effects on Forest Noise Levels: The project effect on forest noise levels would be the same as described for the proposed action as it relates to the construction, operation, and decommissioning of the wellfield and power plant. Transmission line construction and decommissioning would have similar short-term significant impacts on forest noise levels as the proposed action as segment A1 and C1 would also be used for this alternative. The use of segment B2 would also result in short-term significant noise impacts to forest users that may come in close proximity to the line along this segment during construction and decommissioning.

Effects on Sensitive Receptors Near Medicine Lake: The noise effects on sensitive receptors near Medicine Lake under Alternative 3 would be the same as for the proposed action, as the wellfield and power plant would occur on the same site and the transmission line route would follow segment A1, passing just north of Medicine Lake. As for the proposed action, construction and decommissioning under this alternative would result in short-term significant impacts on Medicine Lake receptors. Implementation of Mitigation Measures 4.14.2a through 4.14.2c would minimize these effects, but they would remain significant and unavoidable on a short-term basis.

Effects on Sensitive Receptors Near Tionesta: The noise effects on sensitive receptors near Tionesta under Alternative 3 would be the same for the proposed action, as the transmission line route under this alternative would follow segment C1, as for the proposed action. Construction and decommissioning impacts under this alternative would result in short-term significant impacts on the Tionesta community.

Implementation of Mitigation Measures 4.14.2a through 4.14.2c and 4.14.3a would minimize these effects, but they would remain significant and unavoidable on a short-term basis.

Alternative 4 (Segments A1, B2, C2)

Effects on Forest Noise Levels: The project effect on forest noise levels would be the same as described for the proposed action as it relates to the construction, operation, and decommissioning of the wellfield and power plant. Transmission line construction and decommissioning along segment B2 would have similar short-term significant impacts on forest noise levels as described above for Alternative 3. The noise impacts associated with segment C2 would be the same as described above for Alternative 2.

Effects on Sensitive Receptors Near Medicine Lake: The noise effects on sensitive receptors near Medicine Lake under Alternative 4 would be the same as for the proposed action, because the wellfield and power plant would occur on the same site and the transmission line route would follow segment A1, passing just north of Medicine Lake. Therefore, as for the proposed action, construction and decommissioning would result in short-term significant impacts on Medicine Lake receptors. Implementation of Mitigation Measures 4.14.2a through 4.14-2c would minimize these effects, but they would remain significant and unavoidable on a short-term basis.

Effects on Sensitive Receptors Near Tionesta: The noise effects on sensitive receptors near Tionesta under Alternative 4 would be the same as described above for Alternative 2, as the transmission line route under this alternative would follow segment C2.

Alternative 5 (Segments A3, B1, C1)

Effect on Forest Noise Levels: The project effect on forest noise levels would be the same as described for the proposed action as it relates to the construction, operation, and decommissioning of the wellfield and power plant. Transmission line construction and decommissioning along segments B1 and C1 would also be the same as described for the proposed action. The use of segments A3 would also result in short-term significant noise impacts to forest users that may come in close proximity to the line during construction and decommissioning.

Effects on Sensitive Receptors Near Medicine Lake: The noise effects on sensitive receptors near Medicine Lake under Alternative 5 would be less than for the proposed action as the transmission line route under this alternative would follow segment A3 north from the power plant, avoiding the Medicine Lake area. Siskiyou County noise compatibility standards would not be exceeded at Medicine Lake area receptors during any phase of the project. As no significant or adverse impacts would result, no mitigation would be required.

Effects on Sensitive Receptors Near Tionesta: The noise effects on sensitive receptors near Tionesta under Alternative 5 would be the same for the proposed action, as the transmission line route under this alternative would follow segment C1. Therefore, as for the proposed action, construction and decommissioning would result in short-term significant impacts on the Tionesta community. Implementation of Mitigation Measures

4.14.2a through 4.14.2c and 4.14.3a would minimize these effects, but they would remain significant and unavoidable on a short-term basis.

Alternative 6 (Segments A3, B1, C2)

Effect on Forest Noise Levels: The project effect on forest noise levels would be the same as described for the proposed action as it relates to the construction, operation, and decommissioning of the wellfield and power plant. Transmission line construction and decommissioning along segment B1 would also be the same as described for the proposed action. The noise impacts associated with segment C2 would be the same as described above for Alternative 2. The noise impacts associated with segment A3 would be the same as described above for Alternative 5.

Effects on Sensitive Receptors Near Medicine Lake: The noise effects on sensitive receptors near Medicine Lake, under Alternative 6, would be the same as described above for Alternative 5, as the transmission line route under this alternative would follow segment A3 north from the power plant, avoiding the Medicine Lake area.

Effects on Sensitive Receptors Near Tionesta: The noise effects on sensitive receptors near Tionesta, under Alternative 6, would be the same as described above for Alternative 2, as the transmission line route under this alternative would follow segment C2, avoiding the Tionesta area.

Alternative 7 (No Action)

Alternative 7, the No Action alternative would not result in noise effects at any of the sensitive receptor locations or elsewhere in the National Forests.

4.15 Human Health and Safety

REGULATORY FRAMEWORK

Hazardous Materials

Existing Federal and state regulations for human health and safety relate primarily to potential exposure to hazardous materials. Title 22 of the California Code of Regulations (CCR) defines, categorizes, and lists hazardous materials and wastes. The term "hazardous materials" refers to substances which, if released in an unregulated manner, can be harmful to people, animals, property, and the environment. Title 22 defines a hazardous material as:

> "...a substance or combination of substances which, because of its quantity, concentration, or physical, chemical or infectious characteristics, may either (1) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or (2) pose a substantial present of potential hazard to human health or environment when improperly treated, stored, transported or disposed of or otherwise managed."

Hazardous wastes are categorized in Title 22 as either Resource Conservation and Recovery Act (RCRA) hazardous waste or non-RCRA hazardous waste, depending on whether the waste is regulated under RCRA. Title 22 lists chemical compounds that are presumed to make a material or waste hazardous; these compounds are considered hazardous unless specifically excluded by the U.S. Environmental Protection Agency (EPA).

The definition of types of hazards related to hazardous materials is contained in 29 CFR 1910.1200, which separates potential hazards into two types: health hazards and physical hazards. Health hazards represent direct effects to humans, and include acute (or immediate) hazards and chronic (or delayed and long-term) hazards. Physical hazards are more related to the physical characteristics of the hazard, although these types of hazards can still pose a threat to human health and safety. Included in this hazard category are fire hazards, hazards from sudden releases of pressure, and reactivity hazards. Table 4.15-1 summarizes the characteristics of health hazards and physical hazards.

Fire Hazards

Neither Federal nor state regulations related to risks to human health and safety from fire hazards in forested areas exist. The USFS enforces policies to prevent wildfires to the greatest extent possible and practice controlled, limited-scale burns in order to prevent more serious fires from occurring. The USFS also provides rapid fire suppression response for large-scale wildfires, particularly those that pose a threat to humans and inhabited areas (USFS 1991 and USFS 1995).

Electric and Magnetic Fields

Neither Federal nor California state regulations provide guidelines for, or limit human exposure to electric and magnetic fields from transmission lines or substation facilities.

Table 4.15-1: Types of Hazards Related to Hazardous Materials

Type of Hazard	Characteristics and Classifications
Health Hazards	
Acute or immediate hazard	Includes materials classified as "highly toxic", "toxic", "irritant", "sensitize", and "corrosive", as well as other hazardous chemicals that cause an adverse effect to a target organ where the effect usually occurs rapidly as a result of short-term exposure and is of short duration.
Chronic or delayed hazard	Includes materials classified as "carcinogens" and other hazardous chemicals that cause an adverse effect to a target organ and where the effect generally occurs as a result of long-term exposure and is of long duration
Physical Hazards	
Fire hazard	Includes materials classified as "flammable", "combustible liquid", "pyrophoric", and "oxidizer"
Sudden release of pressure hazard	Includes materials classified as "explosive" and "compressed gas"
Reactivity hazard	Includes materials classified as "unstable reactive", "organic peroxide", and "water reactive"

SOURCE: 29 CFR 1910.1200

KEY ISSUES

No key issues were identified for human health and safety.

SIGNIFICANCE CRITERIA

Appendix G and I of the CEQA Guidelines state that a proposed project would normally have a significant effect on the environment if it would:

- Create a potential public health hazard
- Involve the use, production, or disposal of materials which pose a hazard to people
- Interfere with emergency response or evacuation plans
- Result in the creation of any health hazard or potential health hazard
- Expose people to potential health hazards.

The proposed project would use several materials that could be considered hazardous if present in sufficient concentrations. The proposed project would also require the disposal of these materials. If the proposed project would expose people to these materials or waste in concentrations that would be considered hazardous, the proposed project would have a significant effect. Potential health risks due to air emissions from the proposed project, such as hydrogen sulfide (H_2S), are discussed in Section 4.13, Air Quality.

The significance of fire hazard impacts are based on the severity of the potential impact and the frequency of the impact occurrence. A significant fire hazard would be characterized as having the potential for moderate to severe public risk. This type of risk would include moderate to severe property damage or loss, or human injury or fatality.

Although there are no Federal or California state health standards for EMF exposure, several other states have developed such standards. The states of Florida, Minnesota, Montana, New Jersey, New York, and Oregon each have set varying standards for transmission line electric fields. Montana regulations have established the most stringent standard for electric field exposure. These standards identify the limit of acceptable electric field exposure within a transmission line right-of-way as 7,000 volts per meter (V/m), and the limit of acceptable exposure at the edge of the right-of-way at 1,000 V/m. However, these regulations do not specify the width of the right-of-way (National Institute of Environmental Health Services and U.S. Department of Energy 1995).

Of the six states that have set electric field standards, New York and Florida have also set varying standards for magnetic fields. Florida has established the most stringent standard for magnetic field exposure. The regulations of this state identify the limit of acceptable magnetic field exposure as 150 milligauss (mG) during maximum loading for a 230-kV transmission line. This standard applies to the edge of the transmission line right-of-way (National Institute of Environmental Health Services and U.S. Department of Energy 1995).

In addition to these state standards, two organizations have developed guidelines for exposure to 60-Hz EMF: the International Non-Ionizing Radiation Committee of the International Radiation Protection Association (IRPA), and the American Conference of Governmental Industrial Hygienists (ACGIH). These guidelines are summarized in Table 4.15-2.

PROPOSED ACTION (ALTERNATIVE 1)

4.15.1 Storage, Use, Transport, and Disposal of Hazardous Materials

During the construction, operation, and decommissioning phases of the proposed action, hazardous materials would be stored and used at the proposed wellfield and power plant. These materials would need to be transported to the wellfield and power plant area, and eventually some would require disposal. Fuels, oil, solvents, lubricants and possibly a biocide are the only hazardous materials that would be used during the construction, operation, and decommissioning of the proposed transmission line.

The presence of hazardous materials at the wellfield and power plant would not pose a significant risk to human health and safety because these materials would be stored, used, and handled as directed by the manufacturer and in accordance with Federal and state regulations. Calpine would be responsible for materials once received on site. Mitigation measures are recommended to further reduce the risk for effects to human health and safety.

Construction: During the construction phase of the proposed project, hazardous materials would be transported, stored, and used primarily for development of the

Table 4.15-2: IRPA and ACGIH Guidelines for 60-Hz EMF Exposure

IRPA Guidelines

Type of Exposure	Electric Field (V/m)[1]	Magnetic Field (mG)[2]
General Public (up to 24 hours per day)	5,000	1,000
General Public (few hours per day)	10,000	10,000
Occupational (whole working day)	10,000	5,000
Occupational (short-term)	30,000	50,000

ACGIH Guidelines

Type of Exposure	Electric Field (V/m)	Magnetic Field (mG)
Occupational (whole working day)	25,000	10,000

Notes:

[1] V/m = volts per meter.

[2] mG = milligauss.

SOURCE: National Institute of Environmental Health Services/U.S. Department of Energy 1995

proposed wellfield, which would include the drilling of 9 to 11 two-phase production wells and 3 injection wells in the wellfield and power plant area. Drilling materials used during the construction phase are listed in Table 4.15-3. The potential on-site quantity is provided for each material, as is the health and physical hazard classifications (based on the information summarized in Table 4.15-1 from 29 CFR 1910.1200). Table 4.15-3 specifically focuses on those chemicals that if released in sufficient quantities (in accordance with 29 CFR 1910.1200) could be considered significant.

Materials and chemicals used during drilling operations include Unisteam, and phosphoric or sulfuric acid for flocculating the cuttings. These materials would be kept on location in appropriate containers (i.e., palletized bags, plastic drums, or metal drums). Sodium hydroxide and hydrogen peroxide also would be on location for H_2S abatement during drilling/testing operations. All liquids in containers would be placed inside bermed areas at the rig site. Should a storage container or chemical delivery line break or leak, spill control bermed areas would prevent releases on-site (see Impact 4.15.2 for more discussion of accidental spills and releases).

A typical drilling operation also includes a 20,000-gallon above-ground diesel fuel tank with its own secondary containment. The tank is part of the drilling rig equipment and

Table 4.15-3: Potential Hazardous Materials Used at the Project Site

Chemical/ Component	Trade Name or Purpose	Potential On-Site Quantity	Hazardous Classification [1]
Drilling Activities			
Ethylene Glycol	Antifreeze	55 gallons	Health hazard - toxic
Phosphoric Acid	Buffer 50	300 gallons	Health hazard - highly toxic and corrosive
Diethylene-Triamine	Corrosion inhibitor-Unisteam	330 gallons	Health hazard - highly toxic
Sodium Hypochlorite	Liquid bleach	varies	Health hazard - toxic
Sodium Hydroxide solution	(30%-50%) Caustic soda	6,500 gallons tank	Health hazard - irritant
Petroleum distillate fuel	Diesel fuel	20,000 gallon tank	Fire hazard - combustible liquid
Hydrogen Peroxide (50% concentration)	H_2S abatement	1,000 gallons	Fire hazard - oxidizer
Calcium Silicate	Cement	varies	Health hazard - irritant
Ferric Chloride	Superfloc 1	2-300 gallons	Health hazard - irritant
Ferrous Ammonium Sulfate	Sulfuric acid	varies	Health hazard - highly toxic and corrosive
Plant /Wellfield Operation			
1,1,1-Trichloroethane Mixtures 5-80%	Belzona N.F. degreaser, electric motor cleaner	4/1-liters 16-20 ounce cans	Fire and health hazard - flammable and toxic
Xylene/Toluene	Carboline phenoline thinner	1-5 gallons	Fire hazard - flammable and toxic
EP Glycol Ether	Carboline thinner #4	6 gallons	Fire hazard - combustible liquid
Sodium hypochlorite	Liquid bleach - biocide	80-100 gallons	Health hazard - toxic
Petroleum distillate fuel	Unleaded gasoline	2,000 gallons	Fire hazard - combustible liquid
Calcium Hypochlorite	Sanoril 115	150 pounds	Health hazard - toxic
Sulfuric Acid	Battery bank - plant	120 gallons	Health hazard - highly toxic and corrosive
Ethylene Glycol	Antifreeze	65 gallons	Health hazard - toxic
H_2S Abatement			
Sodium Ammonium Vanadate	Stretford solution	12-35 gallon cans	Health hazard - highly toxic
Anthraquinone Disulphonic Acid	ADA - Stretford solution	10-55 gallon drums	Health hazard - toxic
Hydrogen Peroxide (50% concentration)	Secondary abatement	500 gallons	Fire hazard - oxidizer
Iron Chelate	Secondary abatement	500 gallons	Health hazard - irritant

Notes:

[1] See Table 4.15-1 for details on hazardous classifications

SOURCE: Calpine 1997

would be moved from drill pad to drill pad. Temporary storage of materials and chemicals required for the rig operation would be provided on the well pad inside a bermed area.

The diesel fuel storage tank would be positioned on the drill pad site, and the location would be graded in such a manner that any spillage would flow into the in-ground catchment tanks, which have a total capacity in excess of 2,000 gallons. Earthen berms would be installed to assure that spillage is captured and directed to these in-ground tanks. In the unlikely event of a major release, the capability exists to direct the fluid to the liquid holding basins. Each well drill pad would contain a 750,000 gallon capacity basin and would be lined with an impervious material to prevent fluid loss and ground water contamination. The liner material would meet the Regional Water Quality Control Board permeability standard of $1x10^{-6}$ centimeters per second. Each drill pad basin would provide proper containment facility for geothermal fluids produced from the newly produced wells.

The liquid and solid waste streams generated during the construction phase of the proposed project would be classified according to the applicable regulations. Calpine would test and determine if a "solid waste" meets any of the criteria listed in 40 CFR 261.20 for classification as a "hazardous waste." Solid wastes associated with geothermal energy are generally not considered hazardous wastes regulated under RCRA; however, geothermal waste streams could potentially be identified as California regulated wastes or "non-RCRA" hazardous wastes. All waste streams generated at the Fourmile Hill project would be analyzed by an approved laboratory and disposed of in accordance with local, state, and Federal regulations.

During the construction phase, the transport of materials deemed hazardous based on quantity, would be conducted strictly by licensed hazardous materials transporters. Material Safety Data Sheets (MSDS) would be required for all of these types of materials, and the transport of these materials on regional and forest roads would not be expected to result in exposure of the public to health and safety risks.

As is standard for most geothermal drilling programs, a variety of hazardous materials safety and control plans would be prepared and implemented by Calpine for the proposed drilling activities. These plans include a Hazardous Materials Business Plan, a Spill Prevention and Countermeasure Plan, and a Hazardous Waste Control Plan. These plans would be similar to the hazardous materials safety and control plans that Calpine currently has in place for its existing geothermal activities at The Geysers project. With the implementation of all of the above safety precautions during project construction, the risk to workers and the public from hazardous materials would be minimized, and potential effects to human health from hazardous materials would not be considered significant.

Operation: Operation of the proposed project would primarily involve operation of the proposed power plant and intermittent infill well drilling. The storage, use, transport, and disposal of materials for infill well drilling would be the same as described above for the construction phase, and this drilling would not result in significant effects to human health and safety. The following discussion describes the potential effect to human health and safety from plant operation, including hydrogen sulfide (H_2S)

abatement (see Table 4.15-3 for a list of materials that would be used during plant and wellfield operations and for H_2S abatement).

Power Plant and Wellfield Operations: Typical plant and wellfield operations and maintenance activities would require the use and aboveground storage of various hazardous materials. These materials include diesel fuels, lubricants, paints, thinners, compressed gases, corrosion inhibitors, cement, and sand blasting materials. However, these materials would not be stored or used in quantities that would be considered significant. Power plant and wellfield chemicals would be stored at the plant facility in bermed areas that would provide for spill control. In the event of a spill, the materials would be collected in the bermed areas and would be prevented from being released off-site.

Corrosion inhibitor is expected to be used at the site and would typically be stored in 300- to 500-gallon metal tanks. Storage areas for corrosion inhibitor chemicals would be bermed to contain spills and to prevent any of these materials from being released off-site.

The proposed power plant would include a small chemical laboratory for general on-site analyses purposes. Extremely small quantities of laboratory chemicals would be used and stored at the plant laboratory, and these chemicals would not be present in quantities that would be considered hazardous. Storage and disposal of all lab chemicals would be in accordance with all applicable regulations.

H_2S Abatement: Chemicals used in the Stretford H_2S abatement system would include Anthraquinone Disulphonic Acid, sodium salt, soda ash and sodium ammonium vanadate. These chemicals would be stored inside the bermed plant site within spill control barriers, and no off-site releases of these chemicals would occur. Any liquid spills from the H_2S abatement system would be captured in the containment area and either pumped to the injection system or returned to the Stretford process.

Although H_2S concentrations are expected to be extremely low, if abatement of emissions in the cooling tower is required, appropriate secondary abatement measures would be applied. These secondary abatement measures could include the application of iron chelate or hydrogen peroxide (50% concentration) into the circulating water. Sodium hypochlorite would be used to control biological growth in the circulating water. Storage areas for these chemicals would be bermed to contain spills and prevent any of these materials from being released off-site.

Use of the Stretford H_2S abatement process would require that waste streams (such as cooling tower sludge and sulfur cake) generated during this process be analyzed to determine if the waste stream meets any of the criteria listed in 40 CFR 261.20 for classification as a "hazardous waste." All waste would be transported by a registered hazardous waste hauler to an approved hazardous waste disposal facility.

Similar to the construction phase, transport of materials in quantities deemed hazardous during the operation phase would only be conducted by licensed hazardous materials transporters, and MSDS would be required for all of these types of materials. The transport of these materials on regional and forest roads would not be expected to result in exposure of the public to health and safety risks.

Many of the substances that would be handled and stored at the plant site for plant operations would require that special care be taken to avoid potential effects to the health and safety of workers using these materials. Protective equipment would include goggles to protect against eye irritation, approved respirators to control inhalation exposure, and gloves to protect skin irritation. In addition, the various hazardous materials safety and control plans described above for project construction would be maintained through project operation. With the implementation of the above safety precautions during project operation, the risk to workers from hazardous materials would be minimized, and potential effects to human health from hazardous materials would not be considered significant.

Decommissioning: During decommissioning, hazardous materials generated and stored at the power plant site and within the wellfield area would require proper disposal at the appropriate waste management facilities. Handling, storage, and disposal of this material would be in accordance with applicable Federal and state regulations. In addition, the various hazardous materials safety and control plans described above for project construction and operation would be maintained through project decommissioning. Transport of hazardous materials would be conducted as described for project construction and operation. Disposal methods would be conducted by Calpine in accordance with all applicable regulations.

During the decommissioning phase, formation solids (drill cuttings) generated during the construction and operation phases would be mechanically separated, washed, and deposited in a solids disposal sump at each well pad. The solids produced during drilling activities are expected to be non-hazardous; however, prior to closing the solids sump at each well pad during decommissioning, the dry contents of this sump would be analyzed to confirm that the material was non-hazardous. If the sump contents were determined to be hazardous, the contents would be removed and transported to an off-site disposal facility authorized to accept the waste.

Drilling muds are not anticipated to be hazardous; therefore, the effects on public health and safety would not be significant. As mentioned above, if the solids are determined to be hazardous, the solids would be disposed of in accordance with all Federal and state regulations and the effects to human health and safety would not be considered significant.

Mitigation Measures

No significant effects to human health and safety would be expected to occur from proposed storage, use, transport, and disposal of hazardous materials. Mitigation Measures 4.16.7a through 4.16.7d for impacts related to the provision of emergency services would serve to reduce potential effects on human health and safety from hazardous materials. The following mitigation measures are proposed to further ensure that the potential risk to human health and safety would be minimized:

4.15.1a Calpine shall document appropriate material storage and handling procedures and make these procedures available to workers. Calpine shall also train plant personnel in handling hazardous materials, and place appropriate labels and warning signs on containers and post labels and signs in storage and handling areas. (C, O, D)

4.15.1b Calpine shall follow safe housekeeping practices in storage and handling of all hazardous materials on site. Such practices would include but not be limited to storing reagents and other chemicals in appropriate containers within secondary containment structures, storing chemicals in such a manner as to avoid exposure to other potentially reactive chemicals or to ignition sources, keeping storage areas clean and orderly, cleaning spills as soon as practicable, and following appropriate health and safety measures when handling chemicals. (C, O, D)

4.15.1c Calpine shall submit copies of all hazardous materials safety, control, and emergency response plans to Siskiyou County Environmental Health Services for review and reference. These plans also should be submitted to the USFS, BLM and local fire protection districts for their review and reference in the case of an emergency at the plant site, as these parties would be contacted in such an event. These plans should include information on the potential hazardous materials that could be encountered by emergency response personnel. In addition, the emergency response plan also shall include such items as a list of emergency contact persons, an evacuation plan and notification plan. (C, O, D)

Level of Significance After Mitigation

Less than significant.

4.15.2 Accidental Releases of Hazardous Materials

Hazardous materials would be present at the proposed wellfield and power plant during project construction, operation, and decommissioning. Improper handling of these materials could result in the release of the materials and/or accidental spills, which could lead to human exposure and possible effects on human health and safety. However, the potential for accidental releases of hazardous materials is expected to be low, and would not cause a significant effect to human health and safety.

Construction: Hazardous materials proposed for use during plant construction, if spilled, could have varying effects. Handling, storage, and use of materials as directed by the manufacturer and in accordance with Federal and state regulations would not result in a significant risk to worker health and safety or to the public. As described under Impact 4.15.1, Calpine has proposed a comprehensive system of hazardous material safety and control measures to contain spills and prevent hazardous materials from being released off-site. These measures would prevent accidental releases of hazardous materials during transporting activities on roadway, as well. By implementing these measures, significant effects to human health and safety from accidental releases of hazardous materials would be avoided during project construction.

In general, vapors from hazardous materials can pose a potential threat to human health. Impacts to human health depend on the type and quantity of the hazardous material exposed. Diesel fuel, among other petroleum products, is a hazardous material which does emit vapors and which would be used on the project site. This could pose a potential threat to persons working on site. However, this hazardous material and other materials, as discussed in Impact 4.15.1 under power plant and wellfield operations, would be used in insignificant quantities; therefore, this would not result in a threat to the safety of human health.

Operation: Potential hazards related to the accidental release of hazardous materials during project operation would not be the same as under project construction. H_2S

abatement procedures would be implemented. In addition, adherence to Federal and state regulations in combination with the comprehensive system of hazardous material safety and control measures proposed by Calpine would avoid significant effects to human health and safety from accidental release of hazardous materials during project construction.

Decommissioning: Potential hazards related to the accidental release of hazardous materials during project decommissioning would be expected to be the same as during project construction and operation. Adherence to Federal and state regulations in combination with the comprehensive system of hazardous material safety and control measures proposed by Calpine would be expected to avoid significant effects to human health and safety during decommissioning from accidental release of hazardous materials.

Mitigation Measures

Although no significant effects to human health and safety are anticipated, implementation of Mitigation Measures 4.15.1a through 4.15.1c would serve to minimize the potential risk to human health and safety from accidental release of hazardous materials.

4.15.3 Well Blowout Hazards

During the construction and operation of well drilling, well blowouts could potentially occur with resulting uncontrolled discharge of well fluids and/or gases that could affect human health and safety. The potential for a blowout at the wellfield development area is very low and blowout prevention and control measures are included in the project; therefore, the well blowout hazards would not be significant.

Construction: Well blowouts are accidental, uncontrolled releases of geothermal fluids such as steam, gases, or hot water from a geothermal well during drilling operations. The potential concerns regarding accidental releases of geothermal fluids include effects to surface water and shallow groundwater resources, hazards to workers' health and safety, and effects on air quality from emissions of hydrogen sulfide (see Section 4.13, Air Quality for a discussion of potential effects to air quality from hydrogen sulfide). The specific consequences of a blowout cannot be predicted.

The risk of a blow-out during proposed drilling operations at the well pads would be considered low for a number of reasons. The conditions that increase the potential for blowouts to occur include:

- Drilling in incompetent rocks (soft, sedimentary rocks)
- Use of inadequate casing and cementing
- Use of inexperienced drillers
- Drilling in areas with landslide potential

None of these conditions would occur under the proposed project. Drilling would be accomplished in the highly competent, volcanic rocks that have been demonstrated to exist in the vicinity and that are expected to be encountered at depth. In addition, the drilling program that would be implemented under the proposed project includes a Blowout Contingency Plan. The Blowout Contingency Plan includes installation of

blowout prevention equipment, control procedures, periodic equipment testing, notification procedures, and lists of media contacts. These measures would minimize the potential for blowouts. In addition, the Blowout Contingency Plan will identify proper evacuation and emergency service procedures to be implemented in the unlikely event of a well blowout, and will specifically identify measures to minimize and avoid H_2S exposure. With the implementation of these safety precautions (and the low risk of well blowouts), the risk to workers from well blowouts would be considered low.

If a blow-out were to occur, the geothermal fluid released would drain into the on-site sump; and, Calpine would apply necessary measures and take immediate action to control and correct the blowout. Sumps would be constructed of impermeable materials, thus shallow groundwater resources would not be affected. Surface waters also would not be affected as all geothermal fluids would be contained at or near the site. The closest downstream surface water is perennial and is located approximately 16 miles north of the wellfield area. Furthermore, it is highly unlikely that a sufficient quantity of geothermal fluids would be generated to travel 16 miles over soils of moderate to very rapid infiltration rate to reach the surface water. Fluids could percolate into the subsurface, but because of the depth to the shallow groundwater, it would be absorbed by soils and bedrock before it could mix with groundwater.

Very few blowouts have occurred in geothermal wells. Blowouts have occurred at The Geysers, in northern California, and were effectively controlled by injecting cement slurry into the casing (USFS et al. 1994). Of the hundreds of geothermal wells in the United States, the Geothermal Resources Council has records for only seven blowouts (BLM et al. 1995). The potential for a blowout at the wellfield development area is unlikely. In addition, effective control measures would be implemented; therefore, the potential effects are not considered significant.

Operation: Blowouts could potentially occur during the operation phase. The effects of a blowout are as described above in the construction phase and the effects would not be considered significant. The potential for effect would be lower than in construction as drilling would occur infrequently in the operation phase.

Decommissioning: Blowouts are not be anticipated to occur during the decommissioning phase of the proposed action. As a part of decommissioning, the well hole would be plugged, the well casing would be cut off and capped with a welded plate, and the cellar would be back-filled. These well abandonment procedures would eliminate the potential for blowouts and the effects of well blowouts during the decommissioning phase.

Mitigation Measures

The potential hazards related to well blowouts is expected to be less than significant. In addition, Calpine plans to install blowout prevention equipment at each well, as specified by the GROs. The following mitigation measures are proposed to further ensure that the potential risk to human health and safety from a well blowout would be minimized:

4.15.3a Calpine shall implement the following measures to avoid the effects of potential blowouts in the power plant and wellfield area:

- Wells should be sited away from potential landslide areas
- Proper mud density should be maintained
- Formation pressure should be monitored
- The power plant facility should have an emergency program in the control area which would allow the operator to shut-in a single well, or multiple wells simultaneously, in an emergency situation. (C, O)

4.15.3b In the event of a blowout, Calpine shall take immediate corrective action in accordance with BLM regulations to control the release of geothermal fluids, steam, and gases. (C, O)

Level of Significance After Mitigation

Less than significant.

4.15.4 Geothermal Fluid Hazards

During the construction and operation phases, of the proposed project, workers could be exposed to geothermal fluids during project operations or from unexpected releases. Project procedures would avoid significant effects.

Construction: In the event of a blowout (discussed in Impact 4.15.3), workers could be exposed to geothermal fluids which could result in burns from either steam or hot fluid escaping form the well. Standard safety procedures for blowouts would limit this risk to a very low level.

Workers also could come into contact with geothermal steam and fluids that are brought to the surface during the course of normal drilling and testing. Steam from geothermal fluids may contain noncondensable gases such as carbon dioxide (a majority of the steam), and H_2S, nitrogen, and methane (in smaller amounts). While carbon dioxide will constitute a large portion of the steam, H_2S is the main concern because of its potentially hazardous health effects, especially if exposed to large concentrations. While the proposed project does not involve exposure to large quantities or concentrations of this gas, as part of the proposed project, H_2S emissions would be monitored on a continual basis (see discussion in Section 2.1, Alternatives Including the Proposed Action). In addition, H_2S abatement measures such as use of an H_2S burner-scrubber or implementation of the Stretford process would be incorporated to significantly reduce the potential for this risk.

The primary constituents of geothermal fluids are chloride compounds, similar to the types and concentrations found in seawater. These compounds are somewhat corrosive to metals, but are not considered hazardous to humans during skin contact. Fluids may also contain arsenic, which can cause skin irritation. Hydrogen sulfide and ammonia vapors also could cause temporary eye and nose irritation.

Workers could also come in occasional contact with drilling muds during the drilling of the five deep exploration wells. Drilling fluids are non-hazardous. Typical drilling muds are somewhat alkaline, and brief skin contact with these muds is not considered to be hazardous. See Section 4.3, Hydrology for a discussion of disposal of drilling fluids.

Operation: Geothermal fluid hazards are as described above in the construction phase of the proposed project. As discussed above, H_2S abatement procedures would be

implemented for this phase of the project, as well. Therefore, potential effects associated with geothermal fluids would not be considered significant.

Decommissioning: As described in Impact 4.15.3, all project wells would be plugged and capped during the decommissioning phase. Well abandonment procedures will eliminate the potential for geothermal hazard effects during the decommissioning phase.

Mitigation Measures

Although the potential for geothermal fluid hazards to occur would be less than significant, implementation of Mitigation Measures 4.15.3a and 4.15.3b would serve to further minimize the potential risk to human health and safety.

Level of Significance After Mitigation

Less than significant.

4.15.5 Fire Hazards

The potential for fire hazards to occur in the project vicinity could be increased during all phases of the project because the project would bring additional people, equipment, and machines into the project area. If a wildfire were to occur within the project area, facilities could be destroyed and, possibly, release stored hazardous and volatile materials adding to the fuel of the fire. However, the facility would be equipped with a fire suppression system, and operations would be conducted in accordance with Federal and state applicable fire safety codes and regulations. Adherence to these standards in combination with Calpine's safety measures would be expected to significantly reduce the potential for these types of hazards. The level of risk to human health and safety is expected to be less than significant.

Construction: Several activities during the construction phase of the proposed action could result in the potential for fire hazards. These activities include the use of construction, clearing, and grading equipment at the plant site, wellfield, and transmission line route; the use of drilling rigs and power tools at the plant site and wellfield; welding at the power plant site and pipelines.

In order to minimize the potential for fire hazards from project construction, Calpine would equip all spark-emitting equipment with spark-arresters and would equip exhaust stacks on all diesel or gasoline driven equipment with mufflers. As part of the proposed project, all company and vendor vehicles would carry fire extinguishers, shovels, and buckets. In addition, the Fourmile Hill fire contingency plan would be developed; approved by the USFS, BLM, and Modoc and Siskiyou Counties; and implemented. The fire contingency plan would include information on fire control and fire notification procedures, personnel evacuation plans, fire prevention procedures, and emergency water source locations. These project measures would ensure that the potential for fire from construction, welding, and drilling equipment would not be considered significant.

Welding activities at the power plant site and pipelines could pose the greatest fire potential because of the gases (such as argon, nitrogen, acetylene) that could be used during construction activities. Welding activities could produce sparks which could mix

with the gases causing fire hazards or ignite vegetation. As with other hazardous materials used on site, gases will be stored and used in a safe and cautious manner. In addition, vegetation would be cleared as one of the preliminary construction activities. And, as discussed above, spark-arresters would be used to minimize additional fire risks; thus, the potential for vegetation to catch on fire would be greatly reduced, if not eliminated.

Construction of the power plant, wellfield, and transmission line would require the clearance of vegetation, as described in Section 2.2. Felled trees would be cut to commercial lengths and decked for salvage, as appropriate, sold, or hauled away for disposal. Along the transmission line right-of-way, cleared vegetation would be disposed of in accordance with USFS specifications, and could be hauled from the site for disposal, or scattered over open areas in the right-of-way vicinity.

Operation: During the operation phase, the potential for fire hazard could result from infill drilling, plant operations, and the presence of the proposed transmission line. The potential for fire from infill well drilling would the same as described above for drilling during the construction phase; drilling would not be expected to result in significant effects to human health and safety.

As a part of the proposed project, during project operation, a 50-foot firebreak would be maintained around the power plant. Well pad structures and associated buildings would be concentrated in the middle of each well pad, and would essentially establish approximately a 25-foot firebreak along the perimeter of each wellpad. These fire breaks would help to protect the surrounding areas from any fires which may originate on-site, and help protect the facilities from fires that originate off-site. In the event of a fire, the power plant site would include a 200,000 gallon on-site water storage tank and a 750,000 gallon sump. In addition, the Fourmile Hill fire contingency plan, described above, would continue to be implemented throughout project operation. With the implementation of these safety precautions, the potential for fire hazards and effects to human health from fire hazards would not be considered significant.

The transmission line may pose a threat of fire if a conducting object comes in contact with the transmission line, or if a live phase conductor falls to the ground (see Impact 4.15.7 for a discussion of risks from downed power lines). A common scenario includes one where uncleared vegetation, particularly trees, comes within contact of a line. This vegetation can result in an electrical arc that can ignite combustible material. In order to minimize the potential for this type of hazard to occur, Calpine has proposed to conduct continued vegetation clearance and maintenance along the transmission line during project operation. This clearance would be conducted in accordance with California General Order No. 95 for transmission lines in elevations above 3,000 feet.

Phase conductors may cause fire if they fall to the ground and create an electrical arc that can ignite combustible material; however, this is a very unlikely to occur. The mechanical and structural design, selection of materials, and construction of transmission lines, takes into account normal, as well as unusual structural loads such as ice and wind, that could cause the conductors to break. If for some reason, the conductor were to break, high speed relay equipment would sense that condition and de-energize the line in about one-tenth of a second. This procedure has been proven to

be a reliable safety measure, and has reduced the risk of fire from high voltage transmission lines to an extremely low level (USFS et al. 1994). Therefore, the potential for fire hazards would not be significant.

The proposed wellfield and power plant would be located in an area that has been categorized as having a high fire behavior potential by the Goosenest District. A portion of transmission line Segment A1 would pass through a mosaic of areas with low, moderate, and high fire behavior potentials (USFS 1996). The remainder of transmission line segment A1 and the entire length of segments A2, B1, and C1, as well as the alternative transmission line segments fall within the Doublehead District. These lines also would pass through a mosaic of areas with low, moderate, and high fire behavior potential. However, the measures described above for fire prevention and avoidance and for vegetation clearance would minimize the potential for the plant site and transmission line to be subject to a significant risk of fire hazard.

Decommissioning: The potential for fire during the decommissioning phase is generally the same as described above for the construction phase. With the implementation of the proposed safety procedures, the potential effects of fire would not be significant.

Mitigation Measures

Although the potential for fire hazards to occur would be less than significant, the following mitigation measures are proposed to further reduce any potential risk to human health and safety:

4.15.5a Prior to the commencement of construction activities, a fire contingency plan shall be developed by Calpine. The plan shall include information on fire control and fire notification procedures, personnel evacuation plans, fire prevention procedures, and emergency water source locations. The plan shall incorporate procedures to ensure that vendor vehicles would carry fire extinguishers, shovels, and buckets. And, the construction contractor on behalf of the Calpine, shall ensure that the plan is read, understood, and abided by all persons involved with the physical development of the project, especially persons working on-site. (C, O)

4.15.5b To minimize the risk of fire hazard, Calpine shall prepare a Fire Prevention and Suppression Plan as part of the Fourmile Hill fire contingency plan. This plan shall be acceptable to the USFS, BLM, and Modoc and Siskiyou Counties. The plan shall meet the guidelines set forth by the California Department of Forestry's Industrial Operations Fire Prevention Guide. (C, O, D)

4.15.5c Calpine shall ensure that all construction equipment will be equipped with fire potential reduction gadgets, such as but not limited to spark arresters, mufflers, etc. (C, O, D)

4.15.5d Calpine shall store the chemicals which pose a fire hazard and are associated with plant maintenance and the laboratory in areas which would be constructed of non-flammable, flame retardant material, such as a rigid, steel frame structure with steel panel walls and steel roof. (O)

4.15.5e Calpine shall equip the project facility with a comprehensive fire protection system. This would include detection alarm, and suppression and extinguishing capabilities. These specific detection systems should automatically discharge the extinguishing agent and sound the alarm. (C, O, D)

4.15.5f Calpine shall coordinate with the USFS to clear vegetation for proper fire control. The clearing requirements shall include, but not be limited to: 1) a fifty (50) foot firebreak around the power plant; and 2) vegetative clearing and

maintenance by Calpine along the transmission line during project operation in accordance with California General Order No. 95. (C, O, D)

Level of Significance After Mitigation

Less than significant.

4.15.6 Electric and Magnetic Fields

The operation phase of the proposed project would include the transmission of power along a 230-kV transmission line. This operation would create EMFs along the transmission line corridor, and could expose people to EMFs. However, due to the low levels of EMFs that would be generated by the proposed project, the potential health effects to people in the vicinity of the proposed transmission would not be significant.

Construction: The transmission line would not be energized during the construction phase. Low-levels of EMFs would be generated by generators used for drilling and construction. However, no significant effects would result during construction.

Operation: The transmission line would be energized at the start of the operation phase. When the line is energized, EMFs would be created along the transmission line route. The expected levels of EMFs that humans could be exposed to from the transmission line would be low, and would not pose a significant health hazard.

Tables 3.15-1 and 3.15-2 identify typical electric and magnetic field strength for common household appliances and for a 230-kV transmission line. As illustrated in these tables, the expected exposure to EMFs at 200 feet from the transmission line would be comparable or less than the exposure to EMFs that typically occur with several common household appliances. Areas in the immediate vicinity of the transmission line are used primarily on a temporary basis, which would further reduce the potential for any health effects from exposure to EMFs. Frequent use of areas closer than 200 feet of the transmission line would not be expected to occur on a regular basis; therefore, people would not be exposed to significant levels of EMF from the transmission line.

The proposed transmission line would conform with the most stringent standards established by other states and organizations for EMFs. The highest levels of electric fields that would be generated by the transmission line would be expected to be 2,000 V/m at the source, and about 1,000 V/m at the edge of the 125-foot transmission line right-of-way. These levels would meet the limits established by the state of Montana for electric fields. The magnetic fields generated by the transmission line would be about 15 mG at the edge of the 125-foot transmission line right-of-way; during maximum loading, the magnetic field would be about twice the normal load, or about 30 mG. This level would be below the standard established by the state of Florida for magnetic fields from 230-kV transmission lines. The electric and magnetic field levels generated by the transmission line would also be well below the guidelines identified by IRPA and ACGIH for human exposure to 60-Hz EMFs (see Table 4.15-2).

In the vicinity of the transmission line, there are two areas of human habitation: permanent homes at Tionesta, and seasonal homes at Medicine Lake (see Figure 2.2-2). At Tionesta, the proposed transmission line would be located about 1,500 feet from the closest residences, with other residences located farther from the line. At a distance of 1,500 feet from the transmission line, the expected electric field strength from the line

would be less than 1 V/m, and the magnetic field strength would be less than 0.07 mG (National Institute of Environmental Health Services and U.S. Department of Energy 1995). At Medicine Lake, EMF exposure would be less than the exposure at Tionesta due to the greater distance between the transmission line and the residences (approximately 0.8 miles or 4,000 feet) and the seasonal use of the temporary residences. The EMF exposure levels at Tionesta and Medicine Lake would be well below the IRPA guidelines for 24-hour exposure identified in Table 4.15-2, and would not represent a significant effect to human health and safety.

Potential EMF exposure may also occur in the immediate vicinity of the proposed substation. The strongest EMFs around the outside of a substation come from the power lines entering and leaving the substation. The equipment within the station does not produce significant EMFs beyond the substation fence. The strength of the EMFs from the transformers decreases rapidly with increasing distance, as with household electrical appliances (National Institute of Environmental Health Services and U.S. Department of Energy 1995). EMF exposure in and around the substation would be low; and, therefore not significant.

Power plant workers could be exposed to EMFs from the transformer facility and terminus of the transmission line during employment at the plant site. As stated previously in the section, EMFs decrease with distance from the source. Exposure to any one person would be intermittent, as no one person would be on site 24 hours and working continuously at either one of the particular locations. Based on the estimated EMF levels generated by the 230-kV line, EMF exposure to the line itself would be well below the IRPA guidelines for occupational exposure identified in Table 4.15-2. Therefore, EMF exposure from the proposed project would not pose a significant threat to worker health and safety.

The long-term health effects of EMF exposure have not been conclusively determined. Epidemiological studies are being conducted, as are studies into the biological mechanisms that may be causing health effects (BPA 1993). The body of evidence has not conclusively determined a link between health effects and electric and magnetic fields. However, any long-term human exposure (such as at Tionesta) to EMFs from the operation of the proposed project would occur at extremely low levels; therefore, not posing a significant effect to human health and safety.

Decommissioning: The effects of EMFs during decommissioning would be the same as described during the construction phase. Generators would produce EMFs during this phase of the project. The transmission line would not be energized during decommissioning. This effect would not be significant; therefore, no mitigation is required.

Mitigation Measures

No mitigation measures are recommended.

4.15.7 Downed Power Lines

The potential for downed power lines at the power plant or along the transmission line could potentially cause damage to the project facilities, increase the risk of fire, create electric shock hazards, and interrupt project operations. Most of the potential effects

would be associated with the operation phase of the proposed project. Effects of downed power lines in the project area are not expected to be significant.

Construction: During the majority of the construction phase, power would not be transmitted through the line. However, during the last three to six months of the construction phase prior to the operation phase, the transmission lines would be tested. Power being transmitted through the line at this time could pose a temporary impact to downed power lines. However, due to the limited time of potential for risk, this is not significant.

Operation: The potential effects of downed power lines during the operation phase of the proposed action include damage to the proposed power plant, as well as potential fire damage which could result in immediate hazards to workers. Fire hazards could potentially threaten areas containing hazardous materials described above, in addition to plant buildings (see Impact 4.15.5). Portions of segments A1, A2, and B1 of the proposed transmission line would be located in heavily forested areas. Downed power lines would pose an increased fire risk in heavily forested and densely vegetated areas. Downed power lines could occur during winter when power lines are subject to harsh conditions, such as heavy snow, rain, and wind.

In order to minimize the potential for downed power lines, Calpine would check the transmission line routinely to identify portions of line that are damaged or in poor condition. If damaged or poor condition portions of the line are identified, Calpine would ensure that the areas are repaired. Due to this regular inspection and maintenance, it is expected that the potential effects related to downed power lines would be less than significant.

Decommissioning: The potential for downed power lines during the decommissioning phase of the project are the same as those described above for the construction phase. During decommissioning, power would not be transmitted though the line thus, eliminating the potential for impacts associated with downed power lines. For this reason, the effects of downed power lines would not be significant during the decommissioning phase of the proposed action.

Mitigation Measures

In addition to the mitigation measures identified earlier in the section, all mitigation described to minimize fire hazards (4.15.5a-4.15.5f) would also apply to this impact. No addition mitigation measures to minimize hazards associated with downed power lines are recommended.

4.15.8 Health Risk from Presence of Project Facilities

The wellfield and power plant area and the transmission line would be located in a forested area that is used by a variety of recreationalists, such as hikers, hunters, and mushroom gatherers. Adverse safety risks could be posed if recreationalists are allowed access to the facility or cause disruption of plant activities. Safety measures proposed by Calpine would mitigate the potential for significant effect.

Construction: As part of the proposed project, Calpine would establish fencing around all major construction sites, particularly those sites where construction equipment and

materials would be stored, to prevent public access to construction areas. In addition, due to the aggressive schedule and the limited seasonal window in which project construction activities are to occur, construction personnel would be on-site a majority of the, if not entire, time. Personnel would monitor and discourage any unauthorized individuals attempting to access the construction sites. Therefore, potential human health and safety risks related to project facilities would be less than significant.

Operation: As part of the proposed project, during project operation, the power plant and all sumps at well pads would be fenced to prevent unauthorized access. All major electrical facilities, including the substation, would also be fenced. This fencing would reduce the potential exposure of people to risks from accessing these facilities to less-than-significant levels.

The general wellfield area would not be fenced, which could allow access to the area. Potential risks to recreationalists in the wellfield area would include touching or coming into contact with hot geothermal fluid pipelines. Hunters firing weapons could accidentally strike pipelines, plant equipment, or plant personnel. As part of the proposed project, Calpine would insulate the geothermal fluid pipelines, which would reduce the risk of harm from coming into contact with these pipelines. In addition, the current use of the wellfield area for hunting is limited and could be even more limited with the introduction of project facilities. Although some risks remain during operation, these risks would not represent a significant threat to human heath and safety.

Decommissioning: The potential for risks from the presence of project facilities during the decommissioning phase would be the same as described above for the construction phase; thus, this is considered less than significant.

Mitigation Measures

Although potential risks related to the presence of project facilities would be less than significant, the following mitigation measures are proposed to further reduce any potential risk to human health and safety:

4.15.8a Calpine shall post public notices at access points to the wellfield and power plant area to notify the public of potential risks associated with using the immediate project area for hunting and recreational purposes. Calpine shall ensure public notices remain intact throughout the life of the project. (C, O, D)

4.15.8b Calpine shall post "no shooting" signs in the vicinity of the power plant and wellfield area and ensure those signs remain posted during the entire length of the project. (C, O, D)

Level of Significance After Mitigation

Less than significant.

ALTERNATIVES

The following discussion describes potential effects and recommended mitigation measures for each alternative to the proposed project. Alternatives to the proposed project include various alternate transmission line routes (Alternatives 2 through 6) and the No Action alternative (Alternative 7).

For Alternatives 2 through 6, potential impacts associated with the proposed wellfield and power plant would be the same as described for the proposed project since these

facilities would be the same for all alternatives. Alternatives 2 through 6 would each use at least a portion of the proposed transmission line route, and descriptions of potential impacts along these portions of the transmission line are not repeated under each alternative discussion. The analysis of these impacts focuses on the effects that would be different from those identified for the proposed project and references are provided for those segments that have been previously discussed under the proposed project or a preceding alternative discussion.

Alternative 2 (Segments A1, A2, B1, C2)

The effects of Alternative 2 would be the same as for the proposed project. Under this alternative, the transmission line route would pass farther north from Tionesta; thus, the potential exposure of residents at this location to EMFs would be decreased in comparison to the proposed project. The mitigation measures identified for the proposed project also would apply to Alternative 2.

Alternative 3 (Segments A1, B2, C1)

The effect of Alternative 3 on human health and safety would be the same as for the proposed project. The mitigation measures identified for the proposed project also would apply to Alternative 3.

Alternative 4 (Segments A1, B2, C2)

The effects of Alternative 4 would be generally the same as for the proposed project. Under this alternative, the transmission line route would pass farther north from Tionesta, and thus the potential exposure of residents at this location to EMFs would be decreased in comparison to the proposed project. The mitigation measures identified for the proposed project would also apply to Alternative 4.

Alternative 5 (Segments A3, B1, C1)

The effect of Alternative 5 on human health and safety would be the same as for the proposed project. This alternative would follow transmission line segment A3, which is in an area that has been categorized as having a high fire behavior potential (USFS 1996). Implementation of the measures proposed by Calpine for the proposed project would minimize the potential for the plant site and transmission line to be subject to a significant risk of fire hazard. By routing the transmission line away from the vicinity of the Medicine Lake residences and recreation areas, Alternative 5 would further reduce the potential less-than-significant exposure of people to EMFs in these areas that would occur under the proposed project. The mitigation measures identified for the proposed project would also apply to Alternative 5.

Alternative 6 (Segments A3, B1, C2)

The human health and safety effects of Alternative 6 would be similar to Alternative 5. The fire behavior potential for this alternative would be the same as described under Alternative 5, and fire risk would be reduced by proposed Calpine measures. Similar to Alternatives 2 and 4, the potential exposure of Tionesta residents to EMFs under this alternative would be decreased in comparison to the proposed project. By routing the transmission line away from the vicinity of the Medicine Lake residences and recreation areas, Alternative 6 also would further reduce the potential less-than-significant exposure of people to EMFs in these areas than would occur under the proposed

project. Mitigation measures identified for the proposed project would also apply to Alternative 6.

Alternative 7 (No Action)

Under the No Action alternative, the proposed project would not be implemented, and no potential risks or threats to human health and safety would occur. The mitigation measures identified for the proposed project would not apply to this alternative.

4.16 Socioeconomics

KEY ISSUES

No key issues were identified for socioeconomics.

SIGNIFICANCE CRITERIA

The following significance criteria for socioeconomic effects are based on Appendix G of the CEQA Guidelines and capacity levels established by the various public services and facilities providers. Impacts would be considered significant if the proposed action would:

- Induce substantial growth or concentration of population
- Displace a large number of people
- Substantially decrease property values in the vicinity
- Require an extension of a sewer trunk line with capacity to serve other new development
- Increase demand for existing public services and facilities resulting in exceedance of existing or planned future capacities
- Disproportionately affect minority or low-income populations
- Cause substantial increases in electricity prices

METHODOLOGY

Changes in population, employment, and the demand for housing and public services as a result of the proposed project were estimated. These estimates were then used to determine if the proposed project would substantially change the socioeconomic environment of Siskiyou or Modoc Counties, or exceed these Counties' capacities to provide housing and public services.

PROPOSED ACTION (ALTERNATIVE 1)

4.16.1 Effects on Population

The proposed action would result in an in-migration of population with the influx of approximately 160 temporary and 19 permanent workers to the project area. The in-migration of temporary and permanent workers would not be a significant impact on the populations of Modoc and Siskiyou Counties.

Construction: During the construction phase of the proposed action, the total demand for construction workers would vary. Construction would occur over approximately a three-year period. During the first year, construction activities would primarily involve initial well pad construction and well drilling activities, which would require about 10 to 15 workers. During the second and third years, the construction work force would be gradually increased to complete well pad construction and drilling, plant site construction, and transmission line construction. The number of construction workers would peak during the third year, when approximately 160 construction workers would be required.

Calpine has indicated that they would expect to draw upon the local labor pool for at least a portion of the construction work force. It is expected that about 50 percent of the construction workers would come from the local labor pool, and the remaining 50 percent of required construction workers (about 80 employees) would temporarily relocate to the project vicinity during the construction period. Since the construction jobs generated by the proposed action would be temporary, it is generally not expected that the construction workers relocating to the project vicinity would bring families. The addition of 80 employees to the populations of either Siskiyou or Modoc Counties would represent short-term population increases of 0.2% and 0.8% respectively, which would not have a significant effect on population levels. In addition, it is expected that the construction workers would be distributed throughout the project region, and are not expected to be concentrated in any one community. The in-migration of this number of temporary construction workers would not be a significant impact on population in the project area.

Operation: During the operation phase, the project would be staffed by approximately 19 permanent employees. It is estimated that approximately two-thirds (or approximately 13 persons) of the 19 new full-time plant operations jobs would come from the local labor pool, while the remaining positions (approximately 6 persons) would be filled from within the company (see Impact 3.16.2 below for a discussion of employment impacts). However, it is possible that all permanent employees would relocate to the project region from other areas. Therefore, up to 19 new employees could move into the area. Based on an average household size of 2.87 persons (California Department of Finance 1996), up to approximately 55 persons could permanently move to the area. The addition of 55 people to the populations of Modoc and Siskiyou Counties would represent a population increase of 0.5% and 0.1% respectively. This population increase would not have an adverse effect on population levels. In addition, it is expected that the above population growth would be distributed over a wide geographic area which would not result in significant increases in concentration of population. The increased population would not be a significant impact.

In addition to plant operation during the operational phase, one infill well would be drilled at the wellfield every two years. During this infill drilling, it is anticipated that approximately 10 to 15 workers would be needed. Most of these workers would be Calpine employees or drilling contractor employees; however, up to 50 percent of these workers (5 to 8) may be drawn from the local labor pool. Assuming that no workers are used from the local labor pool, up to 15 temporary workers would reside in the area during the five-month period when infill drilling activities would be conducted. The effects of the temporary addition of up to 15 persons to the local populations of Siskiyou and Modoc Counties would not be significant.

Decommissioning: It is expected that the same number of workers would be needed during the decommissioning phase as in the construction phase. The effect of population in-migration would be the same as described during the construction phase, and therefore the effects would not be significant.

Mitigation Measures

Project impacts would not be significant, and no mitigation is recommended.

4.16.2 Effects on Employment

Short-term increases in employment would be generated by temporary construction workers needed during the construction and decommissioning phases of the project, and from infill well drilling activities. Long-term increases in employment would be generated from the 19 permanent employees expected to be needed at the power plant facility. New jobs created by the proposed project would provide a beneficial impact to the local economy.

Construction: Construction of the proposed project would last approximately 33 months and create up to 160 temporary construction jobs at the plant site and on the transmission line. The maximum number of qualified local skilled/unskilled workers would be incorporated into the work force. Up to 50 percent of the construction work force is expected to be drawn from the local area, with the remaining 50 percent of the jobs filled by individuals from outside the local region. The short-term construction jobs created by the proposed project would contribute to the local economy through the purchase of goods and services by the temporary construction work force during their stay in the area. The additional employment generated by the proposed action would be expected to have a beneficial effect on employment opportunities in the area.

Operation: The proposed project would create approximately 19 permanent jobs in the project area. According to Calpine Corporation, it is estimated that approximately one-third of these positions are expected to be filled from within the company, while the remaining positions would be filled from outside the company and drawn from applicants from a regional advertising program. In addition to the 19 permanent employees, approximately 10 to 15 temporary workers would be needed during drilling activities every two years.

The number of new permanent jobs created directly and indirectly as a result of the proposed action is considered to be moderate, and would not result in significant changes to the local economy and work force of Modoc and Siskiyou Counties. The new jobs created by the proposed action would lead to a slight diversification of the economic base which would be consistent with the Klamath National Forest LRMP and Northwest Forest Plan policies which encourage diversification in the local economy. Overall, the proposed action would provide positive economic and employment effects to the area.

Decommissioning: An estimated 160 temporary construction employees would be needed during the decommissioning phase of the project. The effect of additional workers on employment would be the same as described during the construction phase. The short-term construction jobs created by the proposed project would contribute to the local economy and therefore provide a benefit to Modoc and Siskiyou Counties.

Mitigation Measures

Since the impact on local employment would be considered beneficial, no mitigation is recommended.

4.16.3 Effect on Housing and Lodging

Temporary construction and decommissioning employees required for the proposed action could seek accommodations in both Modoc and Siskiyou Counties. At a

maximum, approximately 160 temporary employees would require some form of temporary housing in the project area. In addition, the proposed project would create a long-term demand for housing in order to accommodate 19 new permanent employees in the project area during the operational phase. Within Modoc and Siskiyou Counties, the projected demand for new housing units could be accommodated and would not be a significant impact.

Construction: The majority of construction workers would be expected to seek out accommodations at nearby RV parks, low-cost motels, or in rental housing. There are 1,066 available housing units (including mobile homes) in Modoc County, 3,045 in Siskiyou County, and 625 in Klamath Falls (California Department of Finance 1996; U.S. Census 1990). There are approximately 20 RV parks in Siskiyou County (BLM et al. 1995b), 10 RV parks in Modoc County (Hironemus 1997, pers. com.), and approximately 9 RV parks in Klamath Falls. The 80 temporary accommodations that would be needed to house employees not drawn from the local labor pool could be supplied by existing housing units, RV parks and motels. Existing housing would be adequate to accommodate the temporary increase in non-resident employees and the rental fees generated by the increased demand for temporary housing would provide a net benefit to local economy. The construction phase of the proposed action would therefore not adversely affect housing or other accommodations in the region.

Operation: The operational phase of the proposed project would result in an in-migration of permanent power plant employees, with a maximum of 19 new households expected to locate in the project area when the plant reaches full operation (assuming all 19 permanent employees come from outside the project region and form a separate household). This would result in a demand for approximately 19 housing units to accommodate the increase in population.

Modoc County's projected population increase by the year 2000 is expected to generate an additional demand for an estimated 464 housing units. Siskiyou County's projected population increase would result in an additional demand for an estimated 1,658 housing units (Department of Finance 1993). There are currently 3,045 available housing units in Siskiyou County, 1,066 in Modoc County, and 625 in Klamath Falls. This supply of vacant housing would be sufficient to accommodate the project population increase. In addition, Siskiyou and Modoc County have development potential and sufficient available lots for the projected population growth numbers. The immigration of a maximum 19 new households would not adversely affect the existing housing supply in the area by increasing demand and reducing housing opportunities. The projected demand for new housing could be accommodated by current vacant housing and is also within the development potential of the project area. Therefore, increased demand for housing would not be a significant impact.

A short-term demand for housing may be created by drilling crews every two years during the infill well drilling periods. However, because of the relatively small number of workers needed and the short-term nature of the activities, existing housing would be adequate to accommodate the workers.

Decommissioning: As described above, at a maximum, 160 temporary construction employees would be needed during the decommissioning phase of the project. The

effect of additional workers on short-term demand for housing would be the same as described during the construction phase and would not be a significant impact.

Mitigation Measures

Although the impact would be considered less than significant, the following mitigation measure is recommended to further reduce the impact.

4.16.3a Calpine shall facilitate the transfer of information about short-term housing opportunities between local businesses and individuals providing housing for construction workers by installing a bulletin board and housing availability file in the construction office.

Level of Significance After Mitigation

Less than significant.

4.16.4 Effect on Minority and Low-Income Populations

The proposed project would be located within the Klamath and Modoc National Forests, and would not directly affect the environmental or human health conditions of any American Indian or other minority or low-income residential communities. The project would disproportionately affect the local American Indians because it could affect tribal use and spiritual values associated with the project vicinity (see Section 4.6, Traditional Cultural Values).

Construction: On February 11, 1994 President Clinton issued an "Executive Order on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." The order was intended to focus Federal attention on environmental and human health conditions in minority and low-income communities by having Federal agencies consider whether their actions would disproportionately affect minority or low-income populations. The Order is further intended to promote non-discrimination in Federal programs substantially affecting human health and the environment and to provide for public participation and access to related information. Opportunities for public participation have been and will continue to be provided through the public scoping process, on-going government-to-government consultation with American Indian tribes in the project vicinity, and the public hearing process.

Construction activities for the proposed project would be located entirely on the Klamath and Modoc National Forests, and not within any residential communities. For this reason, the construction phase of the proposed project would not affect the environmental or human health conditions of any minority or low-income residential communities.

Native Americans have the lowest income per capita in the nation and are considered to be a minority population. The preamble of the American Indian Religious Freedom Act (AIRFA) recognizes that the religious practices of Indian people are an "indispensable and irreplaceable" part of Indian culture. This Act was intended to reaffirm Native American identities and cultures. Indian religions remain a central part of Indian cultures and native traditions. Indian religious beliefs are integrated with all other aspects of life. Particular places are seen as an integral part of native religious and cultural practices. The emphasis on "place" of religious practices is not separated from other cultural aspects, for example, social and political aspects of culture. Impact on a

few practitioners may affect the Native group as a whole since practitioners are well known and their spiritual efforts are extended to the population as a whole.

Construction activities for the proposed action would result in impacts on traditional cultural values associated with American Indian traditional use of sites in the Medicine Lake Highlands. It is not expected that the proposed project would directly impact specific sites used by American Indian tribes (after implementation of Mitigation Measure 4.6.4a). Construction of the proposed project would, however, result in localized noise increases and temporary dust that would indirectly impact the traditional uses of these sites. The visual quality of forest landscapes as seen from various places used by local American Indian tribes would also be impacted. Based on interviews conducted thus far for the proposed project, tribal members believe that the proposed project would have a significant adverse impact on the spirituality of the Medicine Lake Highlands. The proposed action would disproportionately affect American Indian populations that use this area. Please refer to section 4.6 for a detailed discussion of the project impacts on traditional cultural values. The effect of construction would be significant and unavoidable.

Operation: The operation of the proposed project would occur entirely within the Klamath and Modoc National Forests. For the reasons described above, the operation phase of the proposed project would not affect the environmental or human health conditions of any minority or low-income residential communities. Similar to construction, operation of the proposed action would introduce visual, audible, and atmospheric elements out of character with the area. The effect would be significant and unavoidable. Please refer to section 4.6 for a detailed discussion of the project impacts on traditional cultural values.

Decommissioning: Decommissioning activities would occur entirely within the Klamath and Modoc National Forests. For the reasons described above, the operation phase of the proposed project would not affect the environmental or human health conditions of any minority or low-income residential communities. Similar to construction, decommissioning of the proposed action would significantly impact American Indian traditional use and spiritual values associated with the project vicinity. Once decommissioning activities are complete, the project vicinity would eventually be returned to pre-project conditions. Please refer to section 4.6 for a detailed discussion of the project impacts on traditional cultural values. The noise and visual disturbance related to decommissioning would be a significant unavoidable effect.

Mitigation Measures

Implementation of Mitigation Measures 4.6.2a, 4.6.3a, 4.6.3b, and 4.6.7a would reduce project impacts on traditional cultural values and on the American Indian tribal communities.

Level of Significance After Mitigation

Significant unavoidable.

4.16.5 Effect on Local Property Values

Construction, operation, and decommissioning of the proposed project is not expected to decrease property values in the project region.

Construction: The proposed project is located entirely on public lands administered by the USFS. Small enclaves of private land in the project vicinity are located near Medicine Lake and in Tionesta. There are about 35 residences near Medicine Lake and approximately 15 homes in Tionesta. The homes near Medicine Lake are used as recreational or second homes and are not occupied year round. Property values of these residences range from about $30,000 to $125,000 and depend on the condition of the home, type of property improvements, and the date of the last property appraisal (BLM et al. 1995). The homes in Tionesta are permanent residences; property values of these homes range from about $50,000 to $60,000 (Hironemus 1997, pers. com.).

Construction of the proposed project would not be expected to affect property values at Medicine Lake. Construction activities at the wellfield and power plant area would take place over three miles from Medicine Lake, and would be limited to a 3-year period. As discussed in Sections 4.9, Visual Resources, and 4.14, Noise, these construction activities would not be visible from Medicine Lake, and noise generated by these activities would not result in a significant effect to noise levels at Medicine Lake. These construction activities would not be expected to affect recreation in the area (see Section 4.11, Land Use and Recreation), or result in significant air quality effects at Medicine Lake (see Section 4.13, Air Quality). No effect on Medicine Lake property values would be expected from plant construction. Construction of the proposed transmission line near Medicine Lake (segment A1) would be visible to properties near Medicine Lake, and could be audible. However, construction activities at this location would occur in an extremely short period (about three weeks), and would be expected to have a less-than-significant effect on Medicine Lake property values.

Project construction would also not be expected to affect property values in Tionesta. Segment C1 of the proposed transmission line would be constructed near Tionesta (see Figure 2.2-2). Although these construction activities would be visible and audible, they would occur over an extremely short period (about one month), and would not be expected to affect Tionesta property values. In addition, there are five existing transmission line corridors with multiple lines in the vicinity of Tionesta. Placement of an additional transmission line within the area is not expected to negatively affect property values.

Operation: During the operational phase of the proposed action, the transmission line would be visible from properties located at Medicine Lake and Tionesta. However, the wellfield and power plant would not be visible (or audible) from these locations (see Sections 4.9, Visual Resources and 4.14, Noise).

At Medicine Lake, a portion of transmission line segment A1 would be visible. The tops of transmission line support structures and the line itself would be visible from properties at this location. As discussed in Section 4.9, Visual Resources, views of the transmission line from Medicine Lake would be considered a significant and unavoidable visual effect, even after mitigation. However, previous surveys of the effect of transmission lines on property values in rural areas indicate that the presence of the transmission lines would not have a noticeable effect on Medicine Lake property values (Kroll and Priestley 1992; CPUC and BLM 1995). Operation of the proposed action would therefore be expected to have a less-than-significant effect on property values at Medicine Lake.

At Tionesta, a portion of segment C1 of the transmission line would be visible (see Section 4.9, Visual Resources). As discussed under construction, there are five existing transmission line corridors in the vicinity of Tionesta. The proposed transmission line would not be expected to be visually prominent in the landscape around Tionesta, and would not significantly affect views from Tionesta. Property values at Tionesta would therefore not be expected to be adversely affected by project operation.

Decommissioning: Decommissioning of the proposed project is not expected to have an effect on property values in the project region. During decommissioning, all structures and equipment would be dismantled and removed, and the environment would be restored to pre-project conditions, or to conditions acceptable to the USFS and BLM.

Mitigation Measure

Since the impact would considered less than significant, no mitigation is recommended.

4.16.6 Effect on Schools

The proposed action would result in the addition of temporary workers during the construction phase, as well as permanent employees during the operation phase. Children of the additional workers in the area may increase the local school enrollments; however, the children of new workers could be accommodated by the existing capacity in the schools. The impact on schools would not be significant.

Construction: Approximately 160 construction workers would be required during project construction. It is expected that about half of the workers would come from the local labor pool and half would temporarily relocate to the project vicinity from other areas. Since the construction jobs would be temporary, it is generally not expected that any new construction workers with families would relocate their families to the area. However, assuming that 25 percent of the 80 persons (or 20 persons) moving into the area bring their families and that each relocated family includes one to two children, about 20 to 40 students may need to be accommodated within the existing school systems on a temporary basis (i.e., one to three years).

Tulelake and Butte Valley are the two school districts located nearest to the project area. It is assumed that the majority of the 20 to 40 additional students would be divided between these two school districts with a few attending other districts. The Tulelake school district has room for approximately 155 additional students. The Butte Valley district currently has the capacity for an additional 25 students. The Butte Valley district has plans to construct an additional school building which would increase capacity, but the new capacity has not been determined yet. Other school districts in Siskiyou and Modoc Counties and in Klamath Falls, Oregon are generally operating below capacity. The influx of 20 to 40 temporary students to schools in the project vicinity would not be expected to exceed current school capacities and would not be a significant impact. In fact, the influx of new students could have a beneficial impact on local schools by increasing the amount of federal funding the schools receive.

Operation: The addition of up to 19 new permanent households in the project area during project operation would result in an increase in the school-age population in the area. New households generated by the proposed project would marginally increase the

student population. Assuming that all 19 permanent employees relocate from other areas to the project area, all 19 employees have families, and each family includes one to two children, about 19 to 38 students may need to be accommodated by the school systems in the area. For the reasons described under the construction phase, the influx of new students would not exceed the capacity of schools in the project vicinity. Therefore, this would not be a significant impact. As described above, the influx of new students would have a beneficial impact on federal funding to the local schools.

Decommissioning: The effects on local school enrollments would be t generally the same as described during the construction phase and would not be significant.

Mitigation Measures

Project impacts on schools would be less than significant, and no mitigation is recommended.

4.16.7 Effect on Police, Fire Protection, and Emergency Services

The proposed action may result in the increased demand for police, fire protection, and emergency services. The impacts of these increases would be adverse, but not significant.

Construction: Current levels of police services in the Medicine Lake area during the months of recreational use (approximately June to October) would be sufficient to accommodate a temporary influx of 160 construction workers to the area. During the final year of construction, up to 75 construction workers may be working at the power plant and wellfield area during the winter months. This would increase the demand for police services in this area during these months. This would be an adverse, but not significant effect.

The operation of heavy equipment, sparks from blasting or equipment moving over rocks, and fire hazards created by the construction crews are possible sources of fires which could result from the proposed project. A fire contingency plan would be implemented and all company personnel and contractors would be required to read and familiarize themselves with the fire safety plan prior to working at the construction sites. The plant facility would be constructed with required hydrants, a sprinkler, and a deluge system. If the fire protection procedures and safety controls are adhered to, the project would be expected to result in minor adverse, but not significant, impacts to the existing fire and police capabilities.

The small number of construction workers who might move into the cities along the project corridor as a result of the project could potentially exert some increased demand on county fire and police protection services; however, the level of impact would be negligible.

Injuries related to construction activities may increase the demand for emergency services in the project area. Due to the uncertainty of the type or frequency of injuries requiring emergency services that could occur, it is not possible to predict at this time the demand for emergency services by project construction. In order to respond to potential emergencies, Calpine would have a full complement of first aid equipment at the construction sites for the project. Due to the remoteness of the project area, Calpine

would assume responsibility for transport of any injured personnel to hospitals or other treatment facilities. Vehicles would be available for transport of injured personnel, and Calpine would secure a helicopter to transport injured personnel if necessary. A detailed Emergency Contingency plan (similar to the Plans for geothermal operations at The Geysers) would be prepared by Calpine; this plan would detail all emergency response measures for the project. Calpine's planned measures for accident and injury prevention would reduce the need for emergency services. The increased demand for emergency services would be an adverse, but not significant effect

Operation: As described in the construction phase, the plant facility would be constructed with required hydrants, a sprinkler, and a deluge system. In addition, a fire contingency plan would be implemented and all personnel would be familiar with this plan in case of a fire. The nearest fire fighting services to the power plant area are located within Lava Beds National Monument (BLM et al. 1995a) Response time to the power plant is expected to remain the same, as no roads would be closed as a result of the proposed action. The nearest fire fighting services along the transmission line would be located at Lava Beds National Monument and Dry Lake.

The proposed project would increase the demand for police and fire protection and emergency response services provided by the Siskiyou and Modoc County police and fire departments through the addition of 19 new permanent households in the project region. This increase in demand is not expected to adversely affect the level of service in the area. This impact would be adverse, but not significant.

As described for the construction phase, during the operation phase the demand for emergency services may increase slightly as a result of the proposed project. In order to address the need for emergency services, Calpine would provide the same emergency response measures as described for project construction. The increased demand for emergency services during operation would be adverse, but not significant.

Decommissioning: The effect of additional workers on police, fire, and emergency services would be the same as described during the construction phase and would be adverse, but not significant.

Mitigation Measures

Although the impact would be considered less than significant, the following mitigation measures are recommended to further reduce the potential impact.

4.16.7a Calpine shall establish an emergency response facility at the plant site to assist the USFS fire organizations in emergency response. The facility shall include the equipment necessary to provide a first-response to emergency situations at the plant site until the arrival of the USFS fire organizations. (C, O, D)

4.16.7b Calpine shall provide Level A equipment (protective suits, breathing equipment) to respond to hazardous materials spills. (C, O, D)

4.16.7c Calpine shall implement a comprehensive safety program at the plant facility, including safety training for all plant personnel. (C, O, D)

4.16.7d Calpine shall ensure that at least one person during each of the three project phases is trained in basic emergency medical aid, such as wound treatment, bandaging, and cardiopulmonary resuscitation (CPR), in order to respond to potential on-site injuries. (C, O, D)

4.16.7e Calpine shall contract with a private security company to supply guards at the power plant facility. (O)

Level of Significance After Mitigation

Less than significant.

4.16.8 Effect on Water and Sanitary Sewer Services

The proposed action is not expected to increase the demand for water and sewer services. Water will be primarily supplied from a well drilled on-site, and sewer services will be provided with no impact to local sewer facilities.

Construction: During the construction phase, most of the water supply for the proposed project would be obtained by Calpine from the existing groundwater in the area. During the first season of project construction, water would be supplied via a temporary, hand-laid pipeline from wells located in the Arnica Sink area. During the second season of project construction, a groundwater well would be drilled at the wellfield and power plant area to supply the necessary water for well drilling and construction activities. Drinking water for construction workers would be delivered by truck by a bottled water supplier. Utilization of these water sources is not expected to adversely impact the water supply of the nearby communities, or generate a demand for additional water supply (see also Section 4.3, Hydrology).

During project construction, portable toilets would be provided for construction employees. Calpine would contract with a portable toilet service to provide and maintain these facilities. At the end of the construction phase, the portable toilets would be removed from the area. Project construction would therefore not affect sanitary sewer services, or generate the demand for additional service.

Operation: During the operation phase, water supply would be required for domestic uses and drilling of infill wells. Water for drilling infill wells and non-drinking water domestic uses would be supplied from the groundwater well described under project construction (above). Drinking water would be provided by truck by a bottled water supplier, as described above. Plant operations would therefore not result in an increased demand for or affect water services.

The addition of up to 19 new permanent households would not result in significant increases in water consumption. Existing water systems would be expected to be able to accommodate the limited increased demand generated by new residents and would not result in significant impacts to the available water supply in the area.

The proposed power plant includes its own sanitary sewer system in the form of an on-site septic system. Operation of the project would therefore not place any additional demand on sanitary sewer services in the region. In addition, project-generated new households in the area would be expected to be able to be accommodated by existing sanitary sewer systems, and impacts to sewage treatment capacities resulting from new houses would be considered less than significant. Project operation would therefore not affect sanitary sewer services.

Decommissioning: Water for the decommissioning phase of the proposed action would be supplied from the on-site groundwater well and bottled water supplier

described above under project construction. As during construction, portable toilets would be supplied during decommissioning be provided for workers, with no impact to local water or sewer services.

Mitigation Measures

No mitigation is recommended.

4.16.9 Effect on Solid Waste Disposal

Solid waste generated during the construction operation and decommissioning phases of the proposed project would be transported to local landfills. This waste would not have a significant effect on landfill capacities in the project area.

Construction: Solid waste generated during the construction phase of the project would include trash, excess concrete, scrap lumber, paper, and plastic packaging. These wastes would be hauled to an approved waste management unit. This solid waste could be accommodated by the existing landfills. The effect on landfill capacities would not be significant.

Operation: Solid waste generated by the proposed action during the operation phase would include trash, construction debris, and septic waste, in addition to cooling tower sludge, and sulfur cake. Approximately 4 to 12 tons of cooling tower sludge and 240 wet tons of sulfur cake would be generated each year from the operation of the proposed plant. This waste would be evaluated and disposed of in accordance with local, state, and Federal regulations. Septic system sludge would be removed by a licensed commercial septic tank pumping service. In addition, waste would be generated from the additional 19 new households resulting from in-migration is not expected to result in significant adverse impacts on the disposal of solid waste and landfill activity.

As described during the construction phase, the additional solid waste generated by the operation of proposed plant facilities and new households would not affect current landfill operations or accelerate their targeted closure date. Impacts would not be significant.

Decommissioning: At the close of operations, an appropriate decommissioning plan would be developed in cooperation with the USFS. All waste described in the construction and operation phase would be transferred to the appropriate waste management unit. During decommissioning, all structures and equipment would be dismantled and removed. The transmission lines and support poles may be dismantled and removed. The recycling or reuse of materials would be encouraged. The effects of solid waste generation could be accommodated by the existing landfills and would not have a significant impact on local landfill capacities.

Mitigation Measures

Although the impact would be considered less than significant, the following mitigation measure is recommended to further reduce the impact.

4.16.9a Calpine shall establish a waste reduction program at the plant site to minimize the solid waste stream going to the landfill. (C, O, D)

Level of Significance after Mitigation
Less than significant.

4.16.10 Effect on Utility Systems

The proposed action would not significantly affect utility systems during the construction, operation, or decommissioning phases. During the operation phase, the project would deliver electricity to the BPA Malin-Warner transmission line, and therefore feed into the regional power grid.

Construction: No effects to utility systems would occur during the construction phase. Electricity for construction activities would be provided by on-site diesel generators. Construction would not interfere with or interrupt service along the existing utility systems (i.e., transmission lines) in the vicinity of Tionesta.

Operation: The project would deliver approximately 45 MW of electrical power to the regional power grid through a connection to the BPA Malin-Warner transmission line. The power plant would use about 5 MW of its own power generation for the plant operations, so no power demand would be placed on existing utility systems. Project operation would therefore not adversely affect utility systems.

Decommissioning: The removal of project facilities during decommissioning would not affect utility systems in the area. Similar to the construction phase, diesel generators would be used, and decommissioning would not interfere with or disrupt service along existing utility systems in the area.

Mitigation Measures
Since this impact would be less than significant, no mitigation is recommended.

4.16.11 Effect on Public Finance

The proposed action would generate tax revenues, royalties, and employee salaries. Overall, the proposed project would provide positive economic and employment effects to the project area and would have a beneficial impact.

Construction: During the construction phase, employee salaries (and associated taxes) would be generated. In addition, Calpine would pay property taxes for their leases. These revenues would have a beneficial effect on public finance.

Operation: During the operational phase of the proposed project, tax revenues, royalties, and employee salaries would be generated. The state and Siskiyou County would receive revenues from the project as a result of property taxes paid by Calpine. Estimated property taxes for the project would be based on the capital costs of the project and would be approximately $1.3 million per year for the first five years of project operations with a gradual decline in subsequent years. Property tax payments to Siskiyou County over the first 20 years of the proposed project are estimated to be approximately $20 million (Calpine 1996).

Public revenue would also be generated through royalties paid to the Federal government. Current estimates are that Federal royalty payments for the proposed project would total $15 million to $20 million during the first 20 years of the project. Currently 50 percent of these royalties are retained by the Federal government, and 50

percent are passed on to the state of origin. Of the states portion, 40 percent is returned to the county of origin. The royalty sharing would result in an estimated revenue to Siskiyou County from Federal royalties of $3 million to $5 million over 20 years, or approximately $50,000 to $300,000 annually.

Overall, the proposed project would provide positive economic and employment effects to the project area and would have a beneficial impact.

Decommissioning: During the decommissioning phase, beneficial effects on public finance would be similar to as described for the construction phase.

Mitigation Measures

Since the impact would be considered beneficial, no mitigation would be required.

ALTERNATIVES

Alternative 2 (Segments A1, A2, B1, and C2)

The effects of Alternative 2 on socioeconomics and public utilities and services would be as described in the proposed action. All mitigation measures identified for the proposed action would also apply to Alternative 2.

Alternative 3 (Segments A1, B2, and C1)

The effects of Alternative 3 on socioeconomics and public utilities and services would be as described in the proposed action. All mitigation measures identified for the proposed action would also apply to Alternative 3.

Alternative 4 (Segments A1, B2, and C2)

The effects of Alternative 4 on socioeconomics and public utilities and services would be as described in the proposed action. All mitigation measures identified for the proposed action would also apply to Alternative 4.

Alternative 5 (Segments A3, B1, and C1)

The effects of Alternative 5 on socioeconomics and public utilities and services would be as described in the proposed action. All mitigation measures identified for the proposed action would also apply to Alternative 5.

Alternative 6 (Segments A3, B1, and C2)

The effects of Alternative 6 on socioeconomics and public utilities and services would be as described in the proposed action. All mitigation measures identified for the proposed action would also apply to Alternative 6.

Alternative 7 (No Action)

Under Alternative 7 (the No Action alternative), the adverse effects to socioeconomics and public utilities and services from the proposed action would not occur, and the mitigation measures identified for the proposed action would not apply. However, the economic benefits of the project (described in Chapter 2) would also not occur. The No Action alternative would not generate the tax revenues, royalties, or employee salaries that would be generated by the proposed action. No revenues or royalties would be

provided to the Federal, state, or local governments under Alternative 7, and no employee salaries would be paid under this alternative.

4.17 Cumulative Impacts

INTRODUCTION

Both NEPA and CEQA require the consideration of cumulative impacts for a proposed action or project. NEPA Regulations define a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). CEQA Guidelines Section 15355(b) closely follows this definition. CEQA also defines a cumulative impact as two or more individual effects (from either a single project or a number of separate projects) which, when considered together, are considerable or which compound or increase other environmental impacts (CEQA Guidelines Section 15355).

Consistent with NEPA and CEQA, this section of the EIS/EIR addresses the potential cumulative effects of the proposed project and other projects in the vicinity of the proposed project. Pursuant to CEQA Guidelines Section 15130(b)(1)(A), a list of past, present, and reasonably foreseeable future projects that would be expected to produce related or cumulative impacts has been used to determine cumulative effects. Past projects in the vicinity of the proposed project have been considered in the environmental analyses included in this EIS/EIR (see Chapter 4, Environmental Consequences and Mitigation Measures).

CUMULATIVE PROJECTS

A list of present and reasonably anticipated future projects that would be expected to produce related or cumulative impacts is presented in Table 4.17-1. The Siskiyou and Modoc County Planning Departments and the Klamath and Modoc National Forests were contacted in order to develop the list of cumulative projects.

In areas under Siskiyou and Modoc County jurisdiction, only minor projects such as lot parcelizations are currently proposed or reasonably foreseeable in the region of the proposed action. These parcelizations, involving 1 to 10 lots each, are not expected to contribute to cumulative environmental effects in the vicinity of the proposed action as future population and traffic associated with the build-out of these parcels is expected to be minimal. Therefore, no Siskiyou or Modoc County projects have been included in the cumulative analysis for the proposed project.

Reasonably foreseeable future projects on the Klamath and Modoc National Forests were also considered for inclusion in the cumulative analysis for the proposed project. Table 4.17-1 identifies those projects that may contribute to cumulative environmental impacts in the vicinity of the proposed project.

Several other minor projects under consideration on the forests have not been included in the cumulative analysis due to their limited scale, lack of environmental effect, and/or distance from the proposed project. The forest projects include the reissuance of leases for grazing allotments, fishery management decisions, and installation and repair of cattle guards and fences on the forest. In addition, the proposed Sierra Pacific transmission line project was not included in the cumulative analysis due to its distance

Table 4.17-1: Ongoing/Approved and Proposed Cumulative Projects

Cumulative Projects	Location	Description
CalEnergy Telephone Flat Geothermal Development Project	1.5 miles southeast of Medicine Lake in the Modoc National Forest	Proposed 48 MW geothermal power plant, wellfield, and 3-mile transmission tap line
Klamath National Forest Timber Sales	Various locations in the Goosenest Ranger District ranging from less than 1 to 28 miles from the proposed wellfield and power plant	18 commercial timber sales on lands totaling approximately 24,000 acres
Klamath National Forest Underburning	Various locations within the Goosenest Ranger District	1,000 to 2,400 acres per year receive underburning
AMA Research Project	Butte Valley watershed, located west-southwest of the site and south and east of the town of Tennant	Research project to explore silviculture techniques for accelerating old growth; would occur over 2,500 acres affecting a total of 1,800 to 2,000 acres
Eagle Roost Recovery Project	10 miles northwest of the proposed wellfield and power plant, near Three Sisters	Project to accelerate roost recovery by using various silviculture techniques

SOURCE: Modoc and Klamath National Forests 1997

from the project vicinity. This 165-mile transmission line would extend from Alturas, California, to Reno, Nevada. This transmission line would be approximately 32 miles from the easternmost point of the proposed transmission line for the Fourmile Hill project, and 55 miles from the proposed wellfield and power plant site. At these distances, the Sierra Pacific project would not be expected to contribute to cumulative impacts within the project vicinity. The Sierra Pacific project would, however, result in a large temporary work force during construction that may result in the demand for temporary housing in some of the same local communities as the proposed action. Therefore, the Sierra Pacific project is considered in the cumulative analysis related to socioeconomic issues.

Extension of the lifespan of the project and/or retention of the transmission line and utility corridor for the project beyond the 45-year lifespan of the project is also not considered in this cumulative analysis. At the present time, no extension of the lifespan of the project beyond that currently planned is envisioned, and there are no proposals to extend the project lifespan or retain the transmission line or utility corridor beyond the 45-year lifespan of the project. If a decision is made at a later date to extend the project lifespan or retain the transmission line or utility corridor beyond the 45-year lifespan currently planned, authorization of this extension would be subject to additional environmental review and documentation, including an analysis of the cumulative effects of the lifespan extension.

Two exploration programs were conducted to assess the geothermal resources in the area:

- BLM et al. 1995(a). *Fourmile Hill Area Geothermal Exploration Project Environmental Assessment/Initial Study*. EA # CA027-EA95-11. BLM, Susanville District, Alturas Resource Area; U.S. Forest Service, Klamath national Forest, Siskiyou County Air Pollution Control District.
- BLM et al. 1995(B) *Glass Mountain Unit Geothermal Exploration Project Environmental Assessment/Initial Study*. EA # CA027-EA95-06. BLM, Susanville District, Alturas Resource Area; U.S. Forest Service, Klamath National Forest, Siskiyou County Air Pollution Control District, December 1995.

Each of the projects that have been included in the cumulative analysis for the proposed project is described below.

CalEnergy Telephone Flat Geothermal Development Project

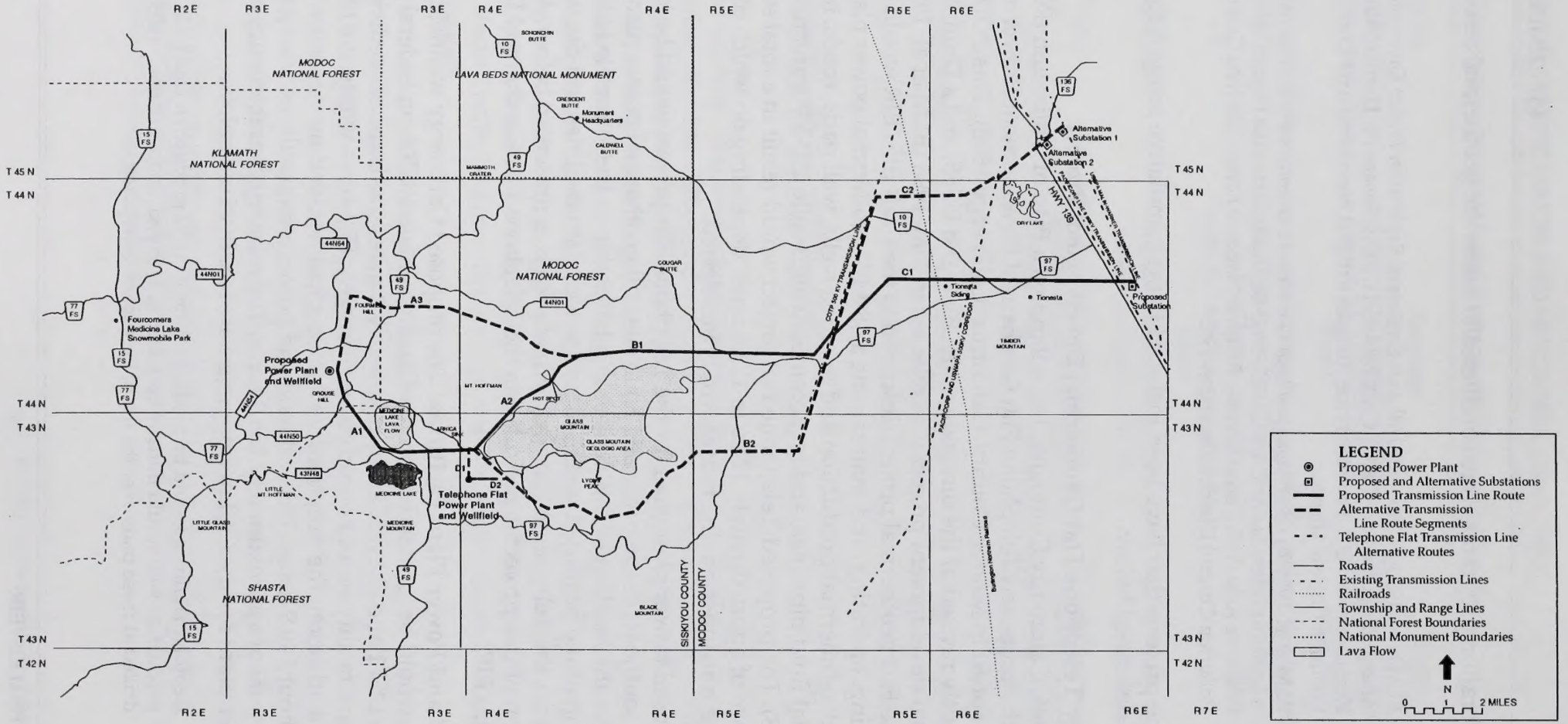
In July 1996, CalEnergy Company, Inc. submitted a Plan of Utilization (POU) to the BLM for the proposed Telephone Flat Geothermal Development Project on the Modoc National Forest in Modoc County, California (CalEnergy 1996). This POU was subsequently revised at the direction of the BLM and USFS, and a Draft EIS/EIR for this geothermal development project was released in May 1998 (BLM et al. 1998). The Telephone Flat geothermal project described in the Draft EIS/EIR would consist of constructing, operating, and maintaining a 48-MW geothermal power plant, with associated geothermal production and injection wells, well pads, roads, interconnected geothermal fluid pipelines, and an accompanying 3-mile 230-kV transmission line (BLM et al. 1998). The proposed Telephone Flat project would result in a total surface disturbance of approximately 171.6 to 173.4 acres, depending on which of two alternative transmission line routes would be selected.

The proposed power plant area for the Telephone Flat project would be located about 4.5 miles southeast of the proposed Fourmile Hill geothermal power plant. Figure 4.17-1 illustrates the location of this project in relationship to the Fourmile Hill project. A description of the proposed wellfield and power plant facilities and the transmission line route for the Telephone Flat geothermal project is presented below. A full description of this project is provided in the Telephone Flat Geothermal Development Project EIS/EIR.

Wellfield and Power Plant Facilities: The proposed CalEnergy wellfield and power plant site would be located within the Glass Mountain KGRA on Federal geothermal leases CA12371 and CA12372, approximately 2 miles southeast of Medicine Lake. The power plant facility would occupy approximately 15.2 acres within the Medicine Lake caldera. In addition, the proposed well pads, pipelines, and new access roads would occupy about 140.9 acres. The wellfield and power plant facilities would therefore occupy a total of approximately 156.1 acres. The primary characteristics of the wellfield and power plant for the CalEnergy project are summarized below:

- Geothermal fluids would be produced from 10 to 12 production well pads. One production well would initially be drilled at each pad, and additional wells may be drilled at these pads over the life of the project as required.

Figure 4.17-1: Location of Telephone Flat Geothermal Development Project



- Approximately 3 to 5 injection wells would be needed to allow for injection of excess geothermal fluids, cooling tower blow down, and other plant effluents into the geothermal reservoir.
- Geothermal fluids would be transported to the proposed power plant and injection wells via cross-country pipelines.
- The proposed double-flash power plant would use geothermal fluids produced from the production wells to generate an average of 48 MW of electricity.
- Electricity generated by the power plant would be directed to on-site transformers, where it would be converted to the appropriate line voltage and fed into the proposed transmission line.

Prior to proposal of the Telephone Flat Geothermal Development Project, CalEnergy had obtained approval for exploration wells in the Telephone Flat and Mt. Hoffman vicinity through the Glass Mountain Unit Geothermal Exploration Project. These wells were approved in August 1995, but have not yet been drilled. The location of these wells are identified in the Glass Mountain Unit Geothermal Exploration Project EA/IS (BLM et al. 1995). The exploration wells included five deep exploration wells (well pads 13-18, 56-18, 58-6, 18-32, and 46-32) and five temperature core hole wells (well pads 34-8TCH, 42-13TCH, 11-24TCH, 15-15TCH, and 63-20TCH). The deep exploration well pads would each occupy approximately 5.51 acres, and the temperature core hole well pads would each occupy approximately 0.15 acres. With the exception of well pad 46-32, all well pads would be at least partially located on old log landings, logging roads, or in previously clear-cut areas. The project also included about approximately 2,600 feet of new access roads and improvements to about 8,150 feet of existing access roads. Total surface disturbance was estimated at approximately 29.6 acres.

Two of the exploration wells have been incorporated into the Telephone Flat project (deep exploration wells 13-18 and 56-18). For the purposes of this cumulative analysis, the remaining eight wells and associated roads have also been included as part of the Telephone Flat project. These components would occupy approximately 18.6 acres. The combination of wellfield facilities included as part of the Telephone Flat project and the Glass Mountain exploration wells would therefore result in a total surface disturbance of about 174.7 acres.

Transmission Line: The Draft EIS/EIR for the Telephone Flat project identifies two alternative 230-kV "tap" transmission lines to the proposed Fourmile Hill transmission line that would deliver the net output of electricity from the proposed CalEnergy power plant to the Fourmile Hill transmission line for transmission to the BPA Malin-Warner line. Each of CalEnergy's alternative tap lines is approximately 3 miles in length. One of CalEnergy's alternative tap lines (identified as transmission line D1) heads directly north from CalEnergy's proposed Telephone Flat plant site to a connection with segment A2 of the proposed Fourmile Hill transmission line. Line D1 would affect approximately 15.5 acres. The other alternative tap line (identified as transmission line D2) heads directly east from the Telephone Flat plant site to a connection with alternative transmission line segment B2. Line D2 would affect approximately 17.3 acres. Implementation of the Telephone Flat project would involve construction of only one of these alternative tap lines.

As discussed in Section 2.2 of this EIS/EIR, the USFS has stated that only one utility corridor would be developed out of the Glass Mountain KGRA for all reasonably foreseeable geothermal power generation at the KGRA. For the purposes of this cumulative analysis, it is assumed that both the Fourmile Hill and Telephone Flat geothermal projects would be approved, and would follow the same utility corridor out of the Glass Mountain KGRA. Since the Fourmile Hill project is farther along in the environmental review process, it is also assumed that the Fourmile Hill project would be approved and implemented before the Telephone Flat project. It is likely that the construction of the CalEnergy Telephone Flat project would overlap with construction of the Fourmile Hill project, as the CalEnergy project is proposed to begin in 1998 or 1999.

Klamath National Forest Timber Sales

A range of commercial timber harvesting activities could occur in the vicinity of the proposed action as a result of up to 18 timber sales, which are expected to be completed by mid-1998 or later. The locations of these possible timber sales are scattered within the Goosenest Ranger District, and these locations range from less than 1 mile to 28 miles from the proposed Fourmile Hill wellfield and power plant. The timber sales could result in timber harvesting activities that would overlap with construction and operation of the proposed action. A total of approximately 24,000 acres would be involved in the timber sales, which would result in the harvesting of approximately 50 million board feet of timber.

Logging operations on the forest use a variety of logging systems, including tractor, cable, and helicopter systems (USFS 1995). On the Goosenest Ranger District, tractor or other ground-based systems are most often used. Typical timber harvesting activities involve a crew size of 15 to 20 people. Equipment typically involves a grader, a cat, skidders, a water truck and fire truck, several crew vehicles, and log hauling trucks. A truck can haul 4,200 board feet of timber or 5,000 board feet of chips. A typical harvest involves hauling about eight trips per day. Most of the timber is hauled to Yreka, Klamath Falls, or the Medford area.

Klamath National Forest Underburning

Approximately 1,000 to 2,400 acres of timber lands per year within the Goosenest Ranger District of the Klamath National Forest would receive some form of controlled burning treatments, which is used primarily to prepare harvested areas for regeneration and to reduce fuel loading and wildlife risk. Typical burn operations in a given area involve two burnings: one in the spring to reduce heavy fuel accumulation, and one in the fall to broadcast burn. A burn crew usually includes 15 to 25 people, 3 engines, a water truck, and several crew rigs. An average crew can perform controlled burning of about 50 to 100 acres per day.

AMA Research Project

The AMA Research Project uses a fifty-year logging contract and prescribed burning to study techniques for accelerating old growth forests within the Goosenest Ranger District on the Klamath National Forest. The project is expected to be established within the next three to five years. The study would be conducted on over 4,625 acres in the Butte Valley watershed, located west-southwest of the site and south and east of the

Town of Tennant. The project would explore a range of silviculture techniques, such as thinning and burning. The total area of impact would be approximately 3,080 acres. The type of equipment that would be used would be similar to those described above for timber sales and underburning, but would be used less frequently.

Eagle Roost Recovery Project

The Eagle Roost Recovery Project would use a range of silviculture techniques, such as thinning and burning, as a means to accelerate roost recovery. The recovery project would occur on the Klamath National Forest near the Three Sisters area, approximately 10 miles northwest of the proposed wellfield and power plant. This project would occur on approximately 600 acres and would last for at least several years. The type of equipment used would be similar to those described above for timber sales and underburning, but would be used less frequently.

CUMULATIVE EFFECTS

The regulations of 40 CFR 1508.25(c) state that the scope of analysis for a proposed action should include an evaluation of the cumulative impacts of the proposed action. Section 15130(a) of the CEQA Guidelines states that cumulative impacts shall be discussed when they are significant; Section 15130(b) states that although the cumulative impact discussion should reflect the severity of the impacts and their likelihood of occurrence, the discussion need not provide as great a level of detail as is provided for the effects of the project alone. A discussion of cumulative impacts should be guided by the standards of practicality and reasonableness (CEQA Guidelines Section 15130(b)). This cumulative impact discussion therefore focuses on those effects of the proposed project that could potentially be cumulatively significant. A discussion of the cumulatively significant effects for all of the environmental parameters discussed in this EIS/EIR (Sections 4.2 through 4.16) is provided; this discussion is presented by parameter in sequential order consistent with Chapter 3 and 4 of this EIS/EIR.

Table 4.17-2 below provides a comparison of the individual and cumulative impacts associated with the Fourmile Hill and Telephone Flat geothermal projects. The impacts are grouped into pre- and post-mitigation levels for each of the various affected environments as presented in the Fourmile Hill Draft EIS/EIR.

Geology and Soils

The proposed project in conjunction with the CalEnergy Telephone Flat project would not result in cumulatively significant geologic impacts related to seismicity, volcanism, landslides, or subsidence. Significant cumulative subsidence effects are not expected to occur from these projects as injection would reduce the loss of the geothermal resource mass and because the reservoir is in competent, noncompressable volcanic rocks. The projects are also relatively small in size and are at a sufficient distance apart that it is likely that production of geothermal fluids would not be extracted from reservoir fracture systems that are connected.

Table 4.17-2: Comparison of Individual and Cumulative Impacts of the Fourmile Hill and Telephone Flat Geothermal Projects

	Fourmile Hill		Telephone Flat		
Affected Environment	**Before Mitigation**	**After Mitigation**	**Before Mitigation**	**After Mitigation**	**Cumulative Effect After Mitigation**
Geology and Soils	—	—	—	—	—
Hydrology and Geothermal	—	—	—	—	—
Vegetation	+	(—)	+	(—)	(—)
Wildlife	+	(—)	+	(—)	(—)
Air Quality	S*	S*	—	—	S*
Cultural Resources	+	(—)	+	(—)	(—)
Traditional Cultural Values	S	S	S	S	S
Noise	S	S	S	S	S
Visual Quality	+	(—)	—	—	—
Land Use and Recreation	—	—	+	(—)	—
Transportation	—	—	—	—	—
Socioeconomics	S	S	S	S	S
Human Health and Safety	—	—	—	—	—

Notes:

— Below significant level of impact

\+ Potentially significant impact

(—) Mitigated to below level of significance

S Significant, unavoidable adverse impact

* There are expected to be short-term PM_{10} impacts in close proximity to construction activities.

SOURCE: MHA Environmental Consulting, Inc. and Telephone Flat Draft EIS/EIR 1998

The proposed project, the Telephone Flat project, and other forest projects would all result in ground disturbance of surface soils. Erosion would not be a significant concern in this area since there is minimal surface water runoff due to the high permeability of surface soils. Significant wind erosion would not be expected to occur in the forested areas. It is projected that the two proposed projects will cause less than significant effects to seismic activity and subsidence in the area. The production and injection of geothermal fluids by the two proposed projects would create minor increases in microseismic activity. However, these increases would be minimal, and would not exceed the additive effects of the two projects. There could also be slight increases in soil subsidence due to the construction and operation of the two proposed projects. However, such increases would be minimal and would not be significant impacts. Standard best management practices, including watering disturbed areas during construction and revegetating disturbed soils once activities are complete, would be employed for all of these projects, and no significant cumulative effect to geology and soils would be expected to occur.

Hydrology

Increased demand on Arnica Sink well water could result if implementation of the proposed project, the Telephone Flat project, and other forest projects overlap. Water would be required for well drilling activities (proposed and Telephone Flat geothermal projects) and for dust control for all of these projects. This impact would not be considered cumulatively significant as the groundwater supply is expected to be sufficient for these and potentially other projects. Upgrading the pumping equipment on these wells, however, may be required in order to adequately serve these projects.

The proposed geothermal production and injection of geothermal fluids is not expected to affect regional groundwater quantity or quality. The geothermal reservoir is not believed to be connected to regional groundwater systems. No cumulative effects of the Calpine and CalEnergy projects are expected to be identified on regional groundwater. Mitigation measure 3.3.1b is designed to monitor groundwater effects.

The proposed project in conjunction with the CalEnergy Telephone Flat project could result in an increased potential for accidental shallow groundwater quality impacts associated with geothermal drilling, production, and injection. Effects could potentially occur to water quality through accidental introduction of geothermal fluids into the shallow groundwater aquifer during drilling or through accidental discharge of geothermal fluids to surface drainages. It is projected that the maximum annual use of shallow groundwater for the two projects would not exceed 115 ac-ft. This amount represents less than one-half of one percent of the evaporation-corrected annualized average groundwater recharge into the Medicine Lake Basin (23, 123 ac-ft/yr). The proposed drilling practices would minimize the potential for effects to groundwater. Mitigation Measures 4.3.6a and 4.3.6b would reduce the impact to a less-than-significant level for the proposed project. Similar mitigation measures could be implemented for the Telephone Flat project.

None of the proposed projects would use surface water. Operation of both the proposed and the Telephone Flat geothermal development projects are expected to have negligible impacts on surface water quality as a result of air emissions. Both projects

would result in geothermal steam or condensate constituents that could be deposited on nearby waterbodies. These effects would not result in significant water quality impacts as concentrations of pollutants from these projects in nearby waterbodies would not be expected to exceed any existing water quality regulatory levels.

Construction of the proposed project, the Telephone Flat project, and implementation of the other forest projects would all result in increased potential for surface runoff and effects on stream channels from vegetation clearing, disturbance of surface soils, and other activities. These effects would not result in cumulatively significant water quality impacts as all projects would be required to adhere to applicable guidelines and implement best management practices. Standard best management practices, including watering disturbed areas during construction and revegetating disturbed soils once activities are complete, would be employed for all these projects.

Geothermal Resources

The operation of both the proposed project and the Telephone Flat project would not result in cumulatively significant impacts on the geothermal reserves. Both of these projects are relatively small in size and their production of geothermal fluids would be relatively minor within the context of the extent of the resources overall. It is also believed that these two projects would produce fluids from separate geothermal reservoir fracture systems. The proposed project site is located outside the Medicine Lake caldera, approximately 4.5 miles from the Telephone Flat project site; the proposed CalEnergy project would be located inside the caldera. Injection of spent fluids from both projects would minimize the geothermal resource mass loss.

As described in section 4.4, Geothermal Resources, the proposed project is not expected to affect the rural waters in regions surrounding Medicine Lake Highlands as the regional thermal features are not connected to the geothermal resource. The CalEnergy project would also not be expected to affect the regional features. No cumulative effect would be expected.

The forest timber and related projects would have no effects on geothermal resources.

Cultural Resources

The proposed project in addition to other cumulative projects would result in surface disturbance that could impact identified and unidentified prehistoric and/or historic sites. While impacts to cultural resource sites from the cumulative projects could potentially result in a net cumulative loss of cultural resource values in the region, a mitigation program such as that proposed in Mitigation Measures 4.5.1a through 4.5.1j would be implemented for all projects on forest lands. These measures emphasize the avoidance of all discovered sites to the maximum extent possible. If it would not be possible to avoid a site, all valuable data would be collected from the site. The proposed project and other cumulative projects would therefore not be expected to contribute to any cumulatively significant effect on cultural resources in the region. In addition, the project region is largely undeveloped and likely contains a large number of undiscovered cultural resources that would not be affected by the cumulative projects or the proposed project. The cumulative effect on cultural resources in the region would not be expected to be significant.

Traditional Cultural Values

The proposed project in addition to the CalEnergy Telephone Flat project and other cumulative projects could potentially result in cumulatively significant impacts on traditional cultural uses associated with American Indian traditional use of the Medicine Lake Highlands. It is not expected that the proposed project or the Telephone Flat project would directly impact specific sites used by American Indian tribes, affect the physical integrity of sites, or deny access to or use of sites. It is unknown at this time whether any of the forest timber or related project would directly impact traditional use sites, but these projects would also contribute to significant cumulative effects if they occur in the Medicine Lake Highlands.

The cumulative projects taken together could result in localized noise increases and temporary dust at sites used by tribal members. The visual quality of forest landscapes as seen from various places used by local American Indian tribes also would be impacted. Based on interviews conducted thus far for the proposed project, the American Indian tribes believe that the proposed project would have a significant adverse impact on the spirituality of the Medicine Lake Highlands. The Telephone Flat project, and the other cumulative projects, would potentially result in incremental contribution to this impact. Mitigation measures have been identified for the proposed project that are also relevant to the other projects that would occur in the Medicine Lake Highlands, including the Telephone Flat project. It is uncertain at this time whether such measures would be sufficient to reduce the impact to a less-than-significant level.

The proposed Klamath National Forest plan amendment to revise standard 24-25 would not be expected to result in cumulative effects as the current standard is considered unenforceable. The level of protection would remain as that prescribed under PL 95-341, the American Indian Religious Freedom Act.

The cumulative impact on traditional cultural values would be considered significant and unavoidable if the cumulative effect was to cause the tribes to choose to discontinue traditional religious practices in the area. On-going government-to-government consultations would continue to pursue both the nature and extent of impacts, as well as the adequacy of mitigation measures.

Vegetation

Implementation of the proposed project and other cumulative projects could impact vegetation in the area. Cumulative impacts to vegetation could result from loss of vegetation through vegetation clearing and ground disturbance.

The cumulative projects would generally involve disturbance and/or removal of large amounts of vegetated land. The total acreage of vegetated land that could be disturbed or removed with the cumulative projects would be approximately 28,600 acres. Of this total, approximately 388.5 acres would be attributed to the proposed project, about 188.9 acres would be attributed to the Telephone Flat, and approximately 28,000 acres would be attributed to the forest timber and related projects.

The proposed project and the Telephone Flat project contribution to the total cumulative vegetation loss would not be considered significant as this removal would be minor at approximately 2 percent of the total acreage of disturbance. It should also

be noted that the Telephone Flat wellfield and power plant site would be located in an area that has been previously logged. The total acreage of vegetation removal and disturbance associated with the Telephone Flat project may therefore be an over-estimate of vegetation loss. The USFS commitment to allow for the siting of only one utility corridor from the Glass Mountain KGRA to the BPA Malin-Warner line would serve to minimize the overall vegetation loss and associated impacts of the two geothermal projects.

The habitat disturbance from the Fourmile Hill and Telephone Flat geothermal projects is shown in Table 4.17-2a. The proposed project would result in a loss of 21.7 acres of late seral stage red fir forest, as well as potential loss of other types of late seral stage forest in the project area and along the proposed transmission line route. Mitigation is identified for the proposed project to avoid and compensate for the loss of this type of forest, and this mitigation would reduce project effects to less-than-significant levels. The Telephone Flat project would also contribute to the loss of late seral stage forest, although this contribution would be expected to be minor to non-existent as the majority of the Telephone Flat facility sites have been previously logged. The timber-related projects may result in cumulatively significant impacts related to loss of late seral stage red fir forest and/or impacts on special status plant species or sensitive plant communities, depending upon the forest and vegetation types that would be impacted. As the USFS would be required to identify and mitigate effects of timber and related projects, it is expected that the cumulative effect on late seral stage forest would be less than significant.

Less-than-significant impacts on special-status plant species and sensitive communities would be likely to occur with both the proposed project (as described in Section 4.7, Vegetation of this EIS/EIR) and the Telephone Flat project, after implementation of mitigation. Mitigation measures requiring floristic surveys to USFS protocol, preconstruction surveys, and routing of project facilities around sensitive areas would serve to mitigate potential impacts to a less-than-significant level. Other cumulative projects would also require avoidance and mitigation of effects to special-status plant species. Therefore, the proposed project and the Telephone Flat project would not contribute to cumulatively significant impacts related to removal/disturbance of special-status plant species or sensitive communities, and a significant cumulative effect would not be expected to occur.

Operation of both the proposed and the Telephone Flat geothermal development projects would cause localized, less-than-significant impacts on vegetation as a result of the deposition of geothermal emissions to the atmosphere. Both projects would result in geothermal steam or condensate emissions of constituents (such as boron) that could be deposited on nearby vegetation, but no significant effects on or loss of vegetation is expected. The projects would not be additive as deposition would be localized near each project's cooling towers (i.e., within 200 meters). The cumulative effect on vegetation from deposition would therefore not be significant.

Table 4.17-2a: Habitat Disturbance Associated with the Fourmile Hill Project and the Telephone Flat Project (in acres)

	Fourmile Hill	Telephone Flat	Cumulative Disturbance
Power Plant and Wellfield			
Lodgepole Pine Forest	26.0	25.9	51.9
Red Fir Forest	1.0	5.5	6.5
Red Fir-Lodgepole Pine Forest/Upper Montane Mixed Conifer Forest[1]	22.0	115.6	137.6
Ponderosa Pine Forest	0.0	0.0	0.0
Lower Montane Mixed Conifer Forest	0.0	0.0	0.0
Juniper Woodland	0.0	0.0	0.0
Big Sagebrush Scrub	0.0	0.0	0.0
Rabbitbrush Scrub	0.0	0.0	0.0
Meadow	0.0	0.0	0.0
Herbaceous	0.3	0.0	0.3
Rock Outcropping	0.4	0.0	0.4
Ponderosa Pine Plantation	0.0	0.0	0.0
Agricultural	0.0	0.0	0.0
Disturbed	0.0	9.1	9.1
Transmission Line[2]			
Lodgepole Pine Forest	140.6	4.0	144.6
Red Fir Forest	20.7	0.7	21.4
Red Fir-Lodgepole Pine Forest/Upper Montane Mixed Conifer Forest	62.7	28.1	90.8
Ponderosa Pine Forest	26.6	0.0	26.6
Lower Montane Mixed Conifer Forest	25.6	0.0	25.6
Juniper Woodland	13.7	0.0	13.7
Big Sagebrush Scrub	7.5	0.0	7.5
Rabbitbrush Scrub	14.9	0.0	14.9
Meadow	2.3	0.0	2.3
Herbaceous	2.5	0.0	2.5
Rock Outcropping	0.0	0.0	0.0
Ponderosa Pine Plantation	20.4	0.0	20.4
Agricultural	0.0	0.0	0.0
Disturbed	1.3	0.0	1.3
TOTAL DISTURBANCE	**388.5**	**188.9**	**577.4**

Notes:

[1] The former vegetation type is used in the Telephone Flat Draft EIS/EIR; the latter is used in the Fourmile Hill Draft EIS/EIR. These types are roughly equivalent.

[2] Includes transmission line access roads and transmission line substation.

Wildlife

Implementation of the proposed project and other cumulative projects could affect wildlife habitat in the area. Cumulative impacts to wildlife habitat and special status wildlife species could result from loss of habitat through vegetation clearing and ground disturbance.

As described above under vegetation, the cumulative projects would generally involve disturbance and/or removal of large amounts of vegetated land and associated wildlife habitat. The total acreage of wildlife habitat removed or disturbed due to cumulative projects would be the same as identified above for vegetation. The proposed project and the Telephone Flat project contribution to the total cumulative acres of wildlife habitat affected would not be considered significant as this removal/disturbance would be a minor contribution (approximately 2 percent) to the total acres affected that are associated with the forest timber and related projects. The general wildlife habitat loss associated with the two geothermal projects would not be considered significant as the types of habitat impacted are common and widespread in the region. Implementation of only one utility corridor from the Glass Mountain KGRA to the BPA Malin-Warner line would serve to minimize the overall wildlife habitat loss and associated impacts of the two geothermal projects.

The proposed project would result in a loss of late seral stage forest and snags greater than 18 dbh that could serve as habitat for special status wildlife species. Mitigation is identified for the proposed project to avoid and compensate for the loss of this type of forest, and this mitigation would reduce project effects to less-than-significant levels. The Telephone Flat project could result in similar effects to late seral stage forest and snags greater than 18 dbh, and mitigation would be required to reduce these effects to less-than-significant levels. The timber-related projects would likely result in cumulatively significant impacts related to impacts on special status wildlife species without mitigation measures. As the USFS would be required to identify and mitigate effects of timber and related projects, it is expected that the cumulative effect on late seral stage forest would be less than significant.

Significant impacts on special-status wildlife species would likely occur with both the proposed project (as described in Section 4.8, Wildlife of this EIS/EIR) and the Telephone Flat project. Significant impacts of the proposed project on special-status wildlife species could be reduced to a less-than-significant level with implementation of mitigation measures identified for the proposed action. It is expected that similar measures would be implemented for the Telephone Flat project if significant impacts occur, as the likely species impacted would be similar. Other cumulative projects would also require avoidance and mitigation of effects to special-status wildlife species. In addition, noise and human disturbance would not be expected to have a significant cumulative effect on special-status wildlife species, for the reasons discussed for the proposed action. Therefore, the proposed project and the Telephone Flat project would not contribute to cumulatively significant impacts to special-status wildlife species, and a significant cumulative effect would not be expected to occur.

Visual Resources

The proposed project in conjunction with the Telephone Flat project would likely increase the number of facilities in the Medicine Lake area that would be visible from KOPs and other vantage points throughout the area. KOPs on the southeastern and southern shores of Medicine Lake would likely see the proposed transmission line along segment A1 and periodic steam plumes rising above the rim of the caldera near Grouse Hill. KOPs on the western and northern shores of the Lake may potentially see the Telephone Flat tap line connection to the proposed transmission line and periodic steam plumes. Night lighting from the Telephone Flat facility may also be visible from various Medicine Lake locations.

These two facilities would contribute to the overall change in the characteristic landscape in the Medicine Lake area and would likely result in cumulatively significant visual impacts. A variety of design and engineering measures could be employed to reduce the overall visibility of these facilities, but they would likely remain visible. Similar to the proposed project, mitigation measures implemented for the Telephone Flat project may also avoid inconsistencies with VQO designations in the Medicine Lake area. However, the overall cumulative effect of the two project in the Medicine Lake area would be considered a significant cumulative effect that would be unavoidable.

Outside of the immediate Medicine Lake area, the siting of only one utility corridor from the Glass Mountain KGRA to the BPA Malin-Warner line would serve to minimize the visual impacts of these two geothermal projects, as only one corridor would be authorized and routed out of the Medicine Lake Highlands.

Forest timber and related projects would not contribute to cumulative visual impacts within the Medicine Lake area as none of these projects would occur within this area. These forest projects, taken together, may contribute to landscape modifications as seen from the forest road system and various other locations. Due to the dynamic nature of the landscape and the minimal timber removal in comparison the overall acreage of timber lands that would remain, these projects would not likely result in a cumulatively significant visual impact.

Plans and Policies

The proposed project, the CalEnergy Telephone Flat project, and the other cumulative projects would be considered consistent with relevant environmental plans and policies, with the exception of the proposed Calpine project inconsistency with the Klamath Forest LRMP Standard 24-25 that assures continued use of sites by Native Americans. The proposed amendment to the Klamath LRMP to revise the standard would make the project consistent with the LRMP. The proposed Klamath National Forest plan amendment to revise standard 24-25 would not be expected to result in cumulative effects as the current standard is considered unenforceable. The level of protection would remain as that prescribed under PL 95-341, the American Indian Religious Freedom Act (see 4.10, Plans and Policies).

The forest and related projects would be expected to be consistent with relevant environmental plans and policies as timber activities are allowed for in the National Forest Plans (USFS 1991a and 1995).

Land Use and Recreation

Recreational Uses: The proposed project, in conjunction with the Telephone Flat project could potentially increase adverse impacts on the recreation experience within the Medicine Lake area. Short-term construction impacts in the Medicine Lake area could potentially increase if construction of these projects overlap. Construction of the proposed transmission line for the proposed project and the Telephone Flat tap line, with associated vehicle travel on Medicine Lake area roads, could impact the overall recreation experience in this area. These construction-phase impacts would be short-term adverse effects, as they would be temporary in nature, and would not be considered a significant effect on the recreation experience. Mitigation Measures identified in the Fourmile Hill Draft EIS/EIR, Section 4.11 Land Use and Recreation, would control construction vehicle access on Medicine Lake area roads, which would serve to minimize impacts on the recreation experience. Mitigation Measure 3.11.3.3.-3 of the Roads and Transportation of the Telephone Flat Draft EIS/EIR further provides for limits on vehicle access on Medicine Lake roads. The Telephone Flat project, with mitigation, would not change the amount of groomed snowmobile trails in the Medicine Lake Highlands. Therefore, the Fourmile Hill project would not contribute to a cumulative effect on this recreational use. Also, it should be noted that recreational snowmobile use would not be impacted by road closures associated with the movement of large vehicles for construction activities, since work on the projects would be limited during winter months.

Operation of the proposed project and the Telephone Flat geothermal project would not result in cumulative impacts on recreation at Medicine Lake. Construction and operation of the proposed project and the Telephone Flat project would not impact recreation uses at the Lava Beds National Monument, if the same mitigation is applied to the Telephone Flat project requiring that the project traffic avoid the Monument.

The timber and related projects would not contribute to recreational impacts within the Medicine Lake area or at the Lava Beds National Monument. These projects may however, impact dispersed recreational activities within close proximity to each of these projects.

Residential Uses: The proposed project, in conjunction with the Telephone Flat project, could potentially increase the short-term construction impacts on Medicine Lake area residences, if construction of these projects overlap. Construction of the transmission lines for these two projects and associated vehicle travel on Medicine Lake area roads could increase noise levels, dust, and the visibility of construction activities. These construction-phase impacts would be short-term adverse effects, as they would be temporary in nature, and would not be considered a significant effect on the recreation experience. Operation of these two geothermal projects would not result in cumulative impacts on the Medicine Lake residences.

The USFS commitment to allow for the siting of only one transmission line utility corridor from the Glass Mountain KGRA to the BPA Malin-Warner line would reduce the potential for additional land use impacts on the community of Tionesta as a result of the Telephone Flat project, as only one line would be routed out of the Medicine Lake Highlands and the proposed Calpine transmission line would have adequate capacity to accommodate the Telephone Flat project power.

The timber and related projects would not impact residential use in the Medicine Lake area, the community of Tionesta, or elsewhere as they would not occur in proximity to residential uses.

Range Land: The proposed and cumulative projects would not result in any additional effects to range land or grazing activities than those identified for the proposed project in section 4.11, Land Use and Recreation. Siting of only one transmission line corridor from the Glass Mountain KGRA to the BPA Malin-Warner line would serve to minimize range land impacts from the two geothermal projects, as only one line would come down out of the Medicine Lake Highlands onto the Modoc Plateau where the range lands are located. The timber and related projects would have no impact on range lands as they would not occur on such lands.

Timber Land: The proposed and cumulative projects would contribute to forest-wide timber losses. The commercial timber harvesting project could impact 24,000 acres of timber, the proposed project could impact approximately 388.5 acres of timber land, and the Telephone Flat geothermal project would impact approximately 65 acres of timber land, most of which has been previously logged. This acreage removed or disturbed would be considered a cumulative unavoidable adverse impact. This impact would not be considered cumulatively significant due to the extensive acreage of timber lands that would remain in both the Klamath and Modoc National Forests and given that the National Forests manage timber land for sustainable commercial timber harvesting and resource protection.

Transportation

The proposed project, in conjunction with the Telephone Flat project could potentially increase short-term traffic conflicts on Medicine Lake area roads, if construction of these projects overlap. Construction of the proposed transmission line for the proposed project and the Telephone Flat tap line, and associated vehicle travel on Medicine Lake area roads could increase the potential for traffic conflicts with recreationalists using this area. These construction-phase impacts would be short-term adverse, as for the proposed project, as they would be temporary in nature. Mitigation measures identified in Section 4.12, Transportation of this EIS/EIR to control and manage construction vehicle traffic would minimize these traffic conflict impacts. Such measures could also be applied to the Telephone Flat project to minimize the potential for traffic conflicts. Operation of these two geothermal projects would not result in cumulatively significant transportation impacts.

The timber and related projects would not contribute to transportation impacts within the Medicine Lake area or at the Lava Beds National Monument. These projects may however, result in localized traffic conflicts due to slow-moving vehicles; these conflicts would be short-term in nature, and would not be cumulatively significant.

Air Quality

The proposed project, the Telephone Flat geothermal project, and other cumulative projects could result in short-term significant air quality impacts related to PM_{10} exceedances of the state 24-hour standard of 50 $\mu g/m^3$ during project construction. These exceedances would be expected to be localized and in close proximity to the construction or timber harvesting activity. As such exceedances would occur only

during the summer season when construction of the geothermal projects and the timber related projects are occurring, cumulative projects would be unlikely to contribute to or cause an exceedance of the annual PM_{10} standard.

If construction of the proposed transmission line overlaps with construction of the CalEnergy Telephone Flat tap line connection to the proposed transmission line, localized PM_{10} concentrations at Medicine Lake receptors could be higher than estimated in this EIS/EIR (see section 4.13). It is unlikely that the other forest projects would result in PM_{10} exceedances in the Medicine Lake area as these projects are located outside of the Medicine Lake area and such effects are typically localized. While concentrations may be higher, mitigation measures identified in Section 4.13, Air Quality would reduce cumulative dust effects in the Medicine Lake area to a less-than-significant level. Minimizing the number of transmission lines from the Glass Mountain KGRA to the BPA Malin-Warner line would serve to minimize increases in PM_{10} concentrations at the community of Tionesta.

Construction and operation-related H_2S emissions from the proposed project and the CalEnergy project would not result in cumulative effects. As discussed in Section 4.13, the proposed project would not result in exceedances of the state 1 hour H_2S standard in the Medicine Lake area, although the project would contribute measurable levels of H_2S. The Telephone Flat geothermal project would also result in measurable levels of H_2S in the vicinity of the power plant, although it is unknown at this time whether such emissions would result in H_2S exceedances in the Medicine Lake area. H_2S emissions from these two projects would not be cumulative in the Medicine Lake area as northerly winds would be required to draw H_2S from the proposed project into the Medicine Lake area, and southerly winds would be required to draw H_2S from the Telephone Flat project into the Medicine Lake area.

Development of the proposed project and other projects could result in increases in other criteria air pollutants from the construction and operation of these projects. However, the potential increases in pollutants would not be expected to result in significant cumulative impacts from the exceedance of any applicable Federal or state ambient air quality standard. The projected emissions from plant operations would be below all air quality standards, and the additional emissions from identified cumulative projects would also be expected to be small and dispersed over a relatively large area.

Construction of the proposed project, if concurrent with the proposed Telegraph Flats action, could cumulatively result in a plume or plumes which are discernible from lava Beds National Monument for short time periods (i.e., depending on sun angle, viewer orientation, etc.)

Noise

The proposed project, in conjunction with the Telephone Flat geothermal project would potentially increase short-term construction noise levels in the Medicine Lake area, if construction of these projects overlap. Construction of the proposed transmission line for the proposed project and the Telephone Flat tap line, and associated vehicle travel on Medicine Lake area roads could increase noise levels. As discussed in Section 4.14, Noise, temporary construction noise levels could exceed county noise standards.

Construction of the proposed project, in conjunction with the Telephone Flat project would result in short-term adverse noise impacts, as for the proposed action.

Table 4.17-3, below, provides a comparison of the worst-case concurrent construction noise estimated to occur as a result of construction of both the Fourmile Hill and the Telephone Flat projects. Noise associated with construction of the well pads nearest to the receptors is expected to be louder than the noise of well drilling. However, the two noisiest events—construction of the nearest segment of the transmission line and of the nearest well pad—are expected to be short-lived (about one week in duration) and would occur during the daytime hours only. The impact is considered to be less than significant.

Table 4.17-3: Estimated Noise Levels ($dBAL_{eq}$) During Concurrent Construction of Worst-Case Periods of the Fourmile Hill and Telephone Flat Projects

Receptor Location	Fourmile Hill Transmission Line	Telephone Flat Nearest Well Pad	Telephone Flat Drilling	Total Noise Level
North campgrounds	62	47	35	62.1
Residences at southeast end of Medicine Lake	52	43	31	52.5

SOURCE: BLM ET AL. 1998

Mitigation measures identified in Section 4.14 would reduce construction phase noise levels and could also be applied to the Telephone Flat project. However, construction of the two projects could result in cumulatively significant (but temporary) noise effects at Medicine Lake.

Construction of only one transmission line from the Glass Mountain KGRA to the BPA Malin-Warner line would eliminate any additional noise effects on the community of Tionesta as a result of the Telephone Flat project, as only one corridor would be routed out of the Medicine Lake Highlands.

Operation of these two geothermal projects would not result in cumulative noise impacts on Medicine Lake residences. As indicated in Section 4.14, operational noise from the proposed project would not be audible in the Medicine Lake area. Operational noise from the Telephone Flat project may be audible due to its proximity to the Medicine Lake area. Audible noise would likely be associated with drilling, although it is not expected that drilling noise would substantially increase ambient noise levels in the Medicine Lake area.

The timber and related projects would not contribute to noise impacts within the Medicine Lake area or in the community of Tionesta since these projects would not occur within proximity to these receptors. These projects may however, result in localized short-term noise increases which could be considered cumulatively adverse,

depending upon whether sensitive noise receptors are located in proximity to these projects.

Human Health and Safety

The proposed project and the Telephone Flat project could potentially affect human health and safety associated with the use of hazardous materials, well blowout hazards, and geothermal fluid hazards. These effects would not result in significant cumulative effects as the potential impacts would be localized within close proximity to the respective wellfield and power plant locations. Mitigation measures identified in Section 4.15, Human Health and Safety would minimize potential health risk to the maximum extent.

Risk of fire would increase with implementation of the proposed project and other cumulative projects, due to additional equipment and transmission line facilities in the area and due to timber-related burning activities. Cumulative fire risk impacts are not expected to be significant due to the expected infrequency of accidental fire and the emergency fire response that would be included as part of the geothermal projects and that is in place within the National Forests.

Since only one utility corridor would be constructed from the Glass Mountain KGRA to the BPA Malin-Warner line for the identified cumulative projects, implementation of these projects would not be expected to result in significant cumulative exposure of Tionesta residents or forest and Medicine Lake users to electric and magnetic fields.

Socioeconomics

The proposed project and cumulative development would result in increases in temporary and permanent populations within the vicinity. Temporary population increases would result from the construction work forces for the proposed project, the Telephone Flat project, Sierra Pacific transmission line construction, and the cumulative timber harvest and sale projects. These temporary increases would be highly variable and would depend on the timing of construction and timber harvesting. In addition, these increases may not be cumulative if construction periods for each project do not occur at the same time. Temporary increases in population would primarily be expected to occur in established communities where lodging and accommodations are available, such as Yreka, Weed, and Alturas.

The proposed project and the Telephone Flat project are the only cumulative projects that would be expected to have associated permanent employment during their operational phases. Assuming that the Telephone Flat project would generate the same number of permanent employment as the Fourmile Hill project, about 40 permanent employees would be required for these two projects. The addition of these employees to the area (assuming in a worst-case scenario that they are all non-local) would not be a significant increase in the population of the area. Since the additional population added to the region would not result in a substantial permanent increase in the population of regional communities, the cumulative increase in population during construction and operation of the cumulative projects would not be considered significant.

The additional population that could be added to the project vicinity by the cumulative projects could result in a cumulative increase in the demand for temporary housing and

accommodations in the area. However, the existing supply of vacant housing and other lodgings in the area would be expected to be sufficient to accommodate any temporary influx of population. The existing housing would therefore be sufficient to accommodate construction workers from outside the local labor force that could move to the area for the jobs generated by the cumulative projects.

The proposed project, in combination with cumulative projects, would not be expected to result in significant adverse cumulative impacts to the following public services: schools, police, fire protection, emergency services, water supply, sanitary sewer, solid waste, or public utility systems. As discussed in Section 4.16, Socioeconomics, the proposed action would not be expected to have an effect on water supply, sanitary sewer, or public utility systems. Demand for the other public services would generally be on a temporary basis, and this demand would be dispersed throughout the region, which would minimize the potential for a significant effect to these services. The permanent demand for these services by the permanent employees of the proposed project and the Telephone Flat project would be expected to be accommodated by the service providers. The identified cumulative projects could therefore be accommodated without adversely affecting the capacities and performance of these systems.

The proposed project and the Telephone Flat project would be expected to have a cumulatively beneficial economic effect. Both of these projects would generate tax revenues, royalties, and employee salaries. Cumulative tax revenues and royalties would be paid to the Federal, state, or local governments, and there would be a cumulative payment of salaries to employees from these projects.

CUMULATIVE EFFECTS OF ALTERNATIVES

This section summarizes the potential cumulative effects of each of the alternatives to the proposed action. For each alternative, the possible cumulative impacts from implementation of the alternative in addition to the cumulative projects identified in Table 4.17-1 have been evaluated. Consistent with Section 15130(a) of the CEQA Guidelines, the discussion of each alternative focuses on those potential cumulative effects that could be considered significant.

The alternatives to the proposed action would have some cumulative effects that would vary from the proposed action. However, most cumulative effects would be the same as the proposed action. In general, the difference in the cumulative effects of each alternative would be related to the differences in the specific effects (i.e., direct and indirect) of the different transmission line route used by each alternative. The discussion provided below focuses on the cumulative effects of each alternative that would vary from those previously described for the proposed action.

Alternative 2 (A1, A2, B1, and C2)

Alternative 2 would have the following differences in cumulative effects than the proposed action:

- Would avoid traditional cultural values at Timber Mountain, which would reduce cumulative effects on traditional cultural values
- Would avoid the Tionesta area and associated adverse visual, air quality, and noise effects, which would reduce cumulative noise, air quality, and visual effects

Alternative 3 (A1, B2, and C1)

Alternative 3 would have the following differences in cumulative effects than the proposed action:

- Would result in a greater cumulative effect on the Medicine Lake Highlands MLSA
- Would avoid contributing to cumulative loss of late seral stage red fir forest by not constructing segment A2 of the transmission line
- Would avoid the Mount Hoffman released roadless area

Alternative 4 (A1, B2, and C2)

Alternative 4 would have the following differences in cumulative effects than the proposed action:

- Would avoid traditional cultural values at Timber Mountain, which would reduce cumulative effects on traditional cultural values
- Would result in a greater cumulative effect on the Medicine Lake Highlands MLSA
- Would avoid contributing to cumulative loss of late seral stage red fir forest by not constructing segment A2 of the transmission line
- Would avoid the Mount Hoffman released roadless area
- Would avoid the Tionesta area and associated adverse visual, air quality, and noise effects, which would reduce cumulative noise, air quality, and visual effects

Alternative 5 (A3, B1, and C1)

Alternative 5 would have the following differences in cumulative effects than the proposed action:

- Would reduce the contribution to significant cumulative impacts on traditional cultural values by avoiding effects around Medicine Lake
- Would avoid contributing to cumulative loss of late seral stage red fir forest by not constructing segment A2 of the transmission line
- Would avoid most contributions to visual impacts in the Medicine Lake area as the transmission line would not be sited through the Medicine Lake caldera.
- Would avoid the Mount Hoffman released roadless area
- Would minimize contributions to cumulative effects on the recreation experience in the Medicine Lake area.
- Would minimize contributions to cumulative short-term noise and air quality effects in the Medicine Lake area.
- Would minimize contributions to traffic conflicts on Medicine Lake area roads.

Alternative 6 (A3, B1, and C2)

Alternative 6 would have the following differences in cumulative effects than the proposed action:

- Would reduce the contribution to significant cumulative impacts on traditional cultural values by avoiding effects around Medicine Lake.
- Would avoid traditional cultural values at Timber Mountain, which would reduce cumulative effects on traditional cultural values

- Would avoid contributing to cumulative loss of late seral stage red fir forest by not constructing segment A2 of the transmission line
- Would avoid most contributions to visual impacts in the Medicine Lake area as the transmission line would not be sited through the Medicine Lake caldera.
- Would avoid the Mount Hoffman released roadless area
- Would minimize contributions to cumulative effects on the recreation experience in the Medicine Lake area.
- Would minimize contributions to cumulative short-term noise and air quality effects in the Medicine Lake area.
- Would minimize contributions to traffic conflicts on Medicine Lake area roads.
- Would avoid the Tionesta area and associated adverse visual, air quality, and noise effects, which would reduce cumulative noise, air quality, and visual effects

Alternative 7 (No Action)

Alternative 7 would avoid all contributions to cumulative effects in the project area.

4.18 Growth-Inducing Impacts

NEPA (40 CFR 1502.16) and CEQA (1508.8(b)) state that an EIS and EIR (respectively) should contain a discussion of indirect effects related to growth-inducing effects that could be caused by the action and would be later in time or farther removed in distance, but still reasonably foreseeable. In addition, CEQA requires a discussion of the ways in which a proposed project could foster or remove obstacles to economic, population, or housing growth, either directly or indirectly, in the surrounding environment (CEQA Guidelines Section 15126(g)).

The potential growth-inducing impacts of the proposed action could include:

- Population and employment growth resulting from the direct and indirect employment needed to construct and operate the proposed project
- Population growth and the potential for additional industrial and commercial development in the region resulting from the availability of additional power that would be generated and transmitted by the proposed project (and the associated potential encroachment into previously unopened/inaccessible areas)
- Induced growth and development of other geothermal facilities at the Medicine Lake KGRA resulting from the success of the project and the presence of a transmission line to transmit power to the regional grid

POPULATION AND EMPLOYMENT GROWTH

The new jobs that would be created by the proposed project could contribute to population growth in the vicinity if new employees move into the area to take permanent employment. If employees move into the area, this could lead to a demand for additional housing, and could affect the provision of existing public services and facilities.

Crews of up to 160 workers would be required during the project construction phase, and an increased demand for housing and/or lodging would result. Since the construction period would only last for three years and there are currently sufficient vacant lodgings to accommodate the construction workforce, this temporary demand for housing and/or lodging would not be expected to significantly impact the supply of existing housing or temporary lodging. The proposed action would generate jobs for about 19 new permanent employees for operation of the power plant and wellfield. This relatively minor increase in permanent employees and associated housing demand in the area would not be significant. Similarly, the potential effect on schools and other public services from population and employment growth would not be significant. These effects of the proposed project are discussed in greater detail in Section 4.16, Socioeconomics.

The new employment provided by the proposed project, especially during construction, would result in slight increases in spending on goods and services and an increased local and state tax base from the project and the families that migrate to the area. These expenditures and tax revenues would be expected to generate mild economic growth in the region. However, the incremental increase in economic growth generated by the proposed project would be negligible given the small and mostly temporary effect of this growth relative to the existing economy of the area.

Increases in temporary population due to the implementation of the proposed project would be unlikely to result in the significant creation of secondary jobs in the region. The temporary construction population would not be expected to result in a significant demand for new services, and would therefore not result in additional new population as a result of people moving into the area to take new service jobs. The permanent employees would be expected to be absorbed into the current level of service provision. The number of growth-induced secondary jobs that would be created by the proposed project would be minor and would not be considered significant employment growth in the area (see Section 4.16, Socioeconomics).

Based on this evaluation of potential growth resulting from the direct and indirect employment needed to construct and operate the proposed project, the proposed action would not be expected to result in significant growth due to these factors. The project would therefore not result in significant growth-induced impacts.

ADDITIONAL POWER GENERATION AND TRANSMISSION

The generation of additional power from the proposed project would incrementally contribute to the overall power supply. A long-term increase in the overall power supply could allow for continued growth in the region. However, the proposed action would actually be intended to provide greater continuity in the provision of electricity in the region, rather than support new growth. The proposed action would supply power into the BPA and Pacific Northwest power transmission system in order to provide more stability in this system, particularly during periods of peak and heavy electrical demand.

If it were assumed that all of the power generated by the proposed action would go to supporting additional households, the proposed 44.9 MW of net power generation could be expected to provide enough electricity to meet the needs of an estimated equivalent of approximately 45,000 families, as discussed in Section 2.2 (Calpine 1996). Given that the electricity generated by the proposed action would be fed into the regional power grid and dispersed throughout the Pacific Northwest, the potential 45,000 additional households (or other development such as industrial or commercial that may occur as a result of the available electricity) that could be supported by the proposed project would be expected to be dispersed throughout the northwestern United States. This additional development would most likely be located in or near established communities that are served by the existing power grid system and have existing electrical distribution systems.

The addition of 45,000 additional households (or other development) to the northwestern United States would not be considered a significant growth-induced effect of the proposed action. In addition, it is not reasonably foreseeable to expect that the availability of power would induce growth in any particular area; it is more likely that other factors such as job availability, the cost of living, and recreational amenities would induce population to the area. The proposed action would not be expected to significantly expand the provision of electrical service beyond the current limits of the provision of this service. The proposed action would therefore not be expected to induce growth related to its generation and transmission of additional electrical power in the region.

DEVELOPMENT OF OTHER GEOTHERMAL FACILITIES

The proposed project would be the first geothermal development within the Glass Mountain KGRA. Approximately 49.9 MW of gross power would be generated by the proposed project, with 44.9 MW of net power available for transmission to the regional power grid. The geothermal resource at the Glass Mountain KGRA has not yet been determined, but could be a few hundred megawatts. The potential of the resource was originally estimated at 500 MW of electric power for a 30-year period (BLM and USFS 1984). This estimate was made on limited information prior to deep well drilling and testing of the resource, and may overstate the potential for electricity generation. The proposed project, however, would develop only a portion of the available geothermal resource.

As part of the Fourmile Hill geothermal project, a transmission line would be installed that would extend from the Glass Mountain KGRA to the existing BPA Malin-Warner transmission line. In preliminary design discussions with the USFS about the proposed project, the USFS expressed a preference that the proposed transmission line for the project be designed to accommodate not only the net electrical power output of 44.9 MW from the proposed project, but also to provide additional capacity for additional geothermal power generation projects that could occur at the Glass Mountain KGRA. The proposed Fourmile Hill transmission line has therefore been designed to have a capacity of approximately 145 MW.

At this time, only one other geothermal power generation project is under consideration at the Glass Mountain KGRA. This project is CalEnergy's proposed Telephone Flat Geothermal Development Project, which would be located about 1.5 miles southeast of Medicine Lake (see Section 4.17, Cumulative Impacts for more information on the proposed CalEnergy project). Exploration activities for this project were proposed in 1994. The proposed Telephone Flat project would generate 48 MW of electric power. If the proposed Fourmile Hill project is approved, it is expected that the CalEnergy Telephone Flat project would construct a tap line to the Fourmile Hill transmission line for transmission of power to the BPA Malin-Warner transmission line.

CalEnergy's proposed Telephone Flat Geothermal Development Project is not being proposed as a result of the proposed Fourmile Hill project. A POU for the CalEnergy project has already been submitted to the BLM (CalEnergy 1996) and the environmental review process for the CalEnergy project has been initiated. These actions have occurred before any approvals have been granted for the proposed Fourmile Hill transmission line. If the proposed Fourmile Hill project is not approved, CalEnergy would proceed with the proposed Telephone Flat project by seeking approval of its own transmission line that would connect to the BPA Malin-Warner transmission line. Since CalEnergy's proposed Telephone Flat project has already been proposed and is proceeding independently of the Fourmile Hill project, the Telephone Flat project has not been induced by the Fourmile Hill project.

If both the Fourmile Hill project and Telephone Flat project are approved, these two projects would use approximately 93 MW of the transmission line capacity, which would leave about 52 MW for other potential future geothermal power generation projects. If only the Fourmile Hill project is approved, about 100 MW of remaining

transmission line capacity would be available to other geothermal development projects. Ultimately, however, the design capacity would not be a limiting factor in geothermal development in the KGRA. Any growth-induced geothermal development could upgrade the design capacity of the line with minimal surface disturbance (e.g., by adding conductors or replacing the proposed line with a higher capacity line). The real limiting factor in geothermal development at the KGRA is the ultimate capacity of the geothermal resource at the KGRA. As discussed previously, the potential of the resource has been estimated at 500 MW of electric power for a 30-year period (BLM and USFS 1984), but this estimate may overstate the actual potential for electricity generation at the KGRA.

Growth inducement could occur if the Fourmile Hill project is successful in identifying a commercial viable geothermal resource with excess reserves. If the Fourmile Hill project is successful, and the market for geothermal power improves, Calpine could pursue additional development on their other leases in the KGRA. Additional CalEnergy development would also depend on the success of the currently proposed geothermal projects and the market for power, as would the potential for other geothermal developers to attempt to acquire leases in the KGRA and develop geothermal projects. If the currently proposed geothermal projects at the KGRA are not successful, it is expected that there would be no growth-inducing effect associated with the project, as there would no reason for growth-induced geothermal development to occur in this area.

Growth-induced geothermal development projects would have similar effects to economic, population, and housing growth as the proposed action. In addition, the growth-induced projects could result in greater surface disturbance, which could result in growth-induced effects to vegetation, wildlife, and cultural resources. The growth-induced geothermal development projects could also have a greater effect on views in the area, as well as recreation, transportation, air quality, and noise. At this time, it would be considered too speculative to attempt to estimate the expected environmental effects of future geothermal development projects, given that the extent of the geothermal resource has yet to be fully explored, that a variety of possible locations could be identified for such projects based on the results of future geothermal exploration, and the uncertainty as to whether growth-induced effects would actually occur. Any other growth-induced geothermal development in the Glass Mountain KGRA would require a separate environmental document.

4.19 Unavoidable Effects

Both NEPA and CEQA require the identification of environmental effects that cannot be avoided if the proposal is implemented (40 CFR 1502.16 and CEQA Guidelines Section 15126(b)). 40 CFR 1502.16 of NEPA allows for a discussion of all potential unavoidable adverse environmental effects. CEQA Guidelines Section 15126(b) provides for a focused discussion of significant unavoidable environmental effects. This section provides a discussion of both types of unavoidable environmental effects.

UNAVOIDABLE ADVERSE EFFECTS

Based on the analyses presented in Sections 4.2 through 4.16 of this EIS/EIR, several environmental effects that cannot be avoided if the proposal is implemented would occur. These adverse effects would be unavoidable even with implementation of mitigation. This list includes adverse effects that would not be significant, as well as those effects that would also be considered significant (significant effects that would be unavoidable are further discussed after this list under "Unavoidable Significant Effects." The unavoidable adverse environmental effects that would occur would include:

- Changes in local topography during the life of the project
- Use of groundwater
- Deposition of cooling tower drift on surface waters in the vicinity, including Medicine Lake
- Disturbance of prehistoric cultural resources
- Potential effects to traditional cultural values and American Indian use of the area
- Removal of vegetation at the wellfield and power plant area and along the transmission line right-of-way
- Deposition of cooling drift on vegetation in the plant site vicinity
- Removal of 22 acres of old growth (i.e., late seral) forest
- Removal of wildlife habitat at the wellfield and power plant area and along the transmission line right-of-way
- Views of the project from project area roads and vantage points at Medicine Lake, Lava Beds National Monument, and Tionesta
- Development of roads in the Mount Hoffman roadless release area
- Changes in the recreational experience for users in the vicinity of the proposed project
- Increased traffic on project area roads from construction activities
- Emissions of PM_{10} and H_2S during project construction and operation
- Potential reductions in regional visibility during well drilling
- Increased noise levels in the immediate project vicinity during project construction and operation
- Increases in employment and population, which would increase the demand on housing, schools, police and fire protection services, and solid waste disposal

UNAVOIDABLE SIGNIFICANT EFFECTS

Almost all adverse environmental impacts that would result from implementation of the proposed project would be reduced to a less-than-significant level with implementation of the mitigation measures identified in Sections 4.2 through 4.16 of this EIS/EIR (see Sections 4.2 through 4.16 for a detailed discussion of environmental consequences and mitigation measures). The proposed project would result in both short-term and long-term significant effects that would be unavoidable even with mitigation. Significant unavoidable short-term environmental effects would be limited to the following:

- **Traditional Cultural Values:** The local tribes have stated their opposition to the proposed project located in the Medicine Lake Highlands and near Timber Mountain. The Medicine Lake Highlands are considered by local tribes to be a sacred area with many traditional use sites important to their cultural and religious practices. The noise, dust, and visual effects of project construction and decommissioning activities would be a short-term effect. The project would not deny tribal members access to identified sites with religious significance, would not deny the right to conduct traditional or religious practices, or affect the physical integrity of identified sites. The noise and visual effects of project construction activities could affect the tribal use of the area for religious or ceremonial purposes. The project has the potential to cause conflicts with established religious use of the area, which would be a significant effect, if tribal members choose to not use the area for traditional religious practices as a result of the proposed project.
- **Construction Noise:** A significant unavoidable short-term construction noise impact would occur if forest visitors come in close proximity to construction activities, as county noise standards could be exceeded. A significant unavoidable short-term construction noise impact would occur in the Medicine Lake area during transmission line construction in proximity to this area, expected to last less than five days. A significant unavoidable short-term construction noise impact would occur in the Tionesta area during transmission line construction in proximity to this area, expected to last less than five days.
- **Construction Air Quality:** A significant unavoidable short-term PM10 impact could occur in close proximity to construction activities. No significant impacts related to an exceedance of the state 24-hour PM10 standard would occur at any of the identified receptor locations evaluated.
- **Visibility:** A significant unavoidable short-term impact on visibility within the adjacent Class I airsheds in Lava Beds National Monument could occur during construction of the proposed project.
- **Low Income and Minority Populations:** The proposed project could have a disproportionate effect on low income and minority population due to the potential for the conflict with American Indian religious practices in the project region. The effects of construction and decommissioning activities would represent potentially significant short-term effects under CEQA.

The following impacts would be considered significant unavoidable long-term environmental effects (i.e., effects that would occur for the life of the project), even after implementation of identified mitigation measures:

- **Traditional Cultural Values:** The consulted tribes conceive of the Medicine Lake Highlands and Timber Mountain areas as a unit with particular interconnected qualities. Within this unit there exists topographic features which possess

capabilities relevant to tribal endeavors. Access to and use of these capabilities are germane to tribal identity (Theodoratus and Emberson 1996). The local tribes have stated that the proposed project would have significant adverse effects on traditional use and sacred sites in the project region, and "...would adversely affect the spiritual significance of Medicine Lake Highlands..." (Pit River Tribe 1996). The project would result in the introduction of visual and audible elements that are out of character with the traditional use sites. The project noise and visible elements would somewhat alter the setting of the sites. The transmission line location near site #14 (a traditional use site) would be the project element closest to traditional use sites identified by local tribal members. This site was not identified as a religious site. The project would not prevent access to the Medicine Lake Highlands or to any specific traditional use sites in the area, or deny the right to practice traditional or religious activities. The project has the potential to conflict with established religious use of the area, which would be a significant effect if tribal members choose to not use the area for traditional religious practices as a result of the proposed project.

- **Visual Resources:** The presence of the transmission line would result in a long-term contrast with the visual character of the project area as seen from Medicine Lake area KOPs, and would result in a significant unavoidable impact
- **Low Income and Minority Populations:** The proposed project could have a disproportionate effect on low income and minority population due to the potential for the conflict with American Indian religious practices in the project region. The effects of the project operation would represent potentially significant long-term effects under CEQA.

Selection of Alternatives 5, 6, or 7 (the No Action alternative) would avoid the significant visual effects from construction of the proposed transmission line in the Medicine Lake area. These alternatives would also reduce the effects on Traditional Cultural Values.

4.20 Short-Term Use Versus Long-Term Productivity

40 CFR 1502.16 and CEQA Guidelines Section 15126(e) require that an EIR/EIS contain a discussion of the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity. This discussion should:

- Describe the cumulative and long-term adverse environmental effects of the proposed project, with special attention given to impacts that would narrow the range of beneficial uses of the environment or pose long-term risks to health or safety
- Explain why the proposed project is believed by the sponsor to be justified now, rather than reserving an option for further alternatives (CEQA Guidelines Section 15126(e))

CUMULATIVE AND LONG-TERM ADVERSE ENVIRONMENTAL EFFECTS

Potential cumulative environmental effects of the proposed project are discussed in Section 4.17, Cumulative Impacts. The long-term environmental effect of the proposed project would include establishment of a wellfield, power plant, transmission line utility corridor, and substation. This development would result in the conversion of currently undeveloped land to industrial and utility uses for the 45-year life span of the project.

The proposed project would develop electrical power through use of the geothermal resource at the Glass Mountain KGRA. This resource is generally considered to be a renewable resource, meaning that the resource can renew itself over time and maintain productivity. Renewable resources are different from most energy resources (such as oil and gas reserves) that have been used for traditional power generation; these types of resources can be depleted over time. The development of the project in the short term and the use of the geothermal resource over the long term would not be expected to result in long-term adverse environmental effects to the geothermal resource. Based on current knowledge, the long-term productivity of the geothermal resource would not be expected to be significantly jeopardized by project implementation (see Section 4.4, Geothermal Resources, for more information on potential impacts to the geothermal reservoir).

Geothermal power generation is considered to be an alternative energy source, which is encouraged by Federal energy policies and the BPA (see Section 1.2, Purpose and Need). Use of the geothermal resource for power generation would be relatively benign in comparison to other power generation methods, such as coal-fired plants or hydroelectric dams. Development of the proposed project (as well as other geothermal and alternative power projects) is essential on a regional and national basis to assist in moving towards a greater reliance on alternative and renewable power in the long-term, and away from traditional power generation methods that require imported fossil fuels. The project would provide long-term environmental advantages over traditional power generation sources, such as reduced emission of air pollutants and less dependency on fossil fuel-based energy sources.

The proposed action would supply power into the BPA and Pacific Northwest power transmission system, which would improve the stability of this system. The proposed 44.9 MW of net power generation could be expected to provide enough electricity to meet the needs of an estimated equivalent of approximately 22,500 families during the life of the project. This aspect of the proposed project would be a long-term benefit that would have minimal short-term environmental effects, in comparison to more traditional power generation methods.

Implementation of the proposed project would not be expected to result in significant long-term restrictions of existing land uses in the vicinity of the proposed project, due to the rural and undeveloped nature of the surrounding National Forest lands. Existing uses, such as recreation, residential, timber harvesting, grazing, and mining would not be significantly limited or affected by the proposed action. Native American use of the area would not be restricted or denied as a result of the proposed project. Views of and noise from the project may cause tribal members to choose to discontinue or change their traditional or religious use of areas in the project vicinity.

The proposed project would not be expected to pose long-term risks to health or safety. Although hazardous materials would be stored and handled at the plant site, a Hazardous Materials Business Plan would be prepared for the proposed project (see Section 4.15, Human Health and Safety). This Plan would include safety and storage guidelines for hazardous materials, an inventory of all hazardous materials stored at the site, and guidelines for the proper disposal of any hazardous waste. The Plan would ensure that there would be no long-term risk to health or safety from hazardous materials.

The operation of the proposed transmission line for the project would present an additional source of electric and magnetic fields (EMFs) along the proposed transmission line right-of-way. As discussed in Section 4.15, Human Health and Safety, the estimated EMF levels from the proposed transmission line would not be expected to represent a long-term risk to human health or safety. The nearest residences to the transmission line would be at Tionesta; these residences are approximately 1,500 feet from the transmission line. At this distance, EMF levels from the transmission line would be comparable or less than EMF levels from common household appliances. For users of the forest (including Medicine Lake), any exposure to EMFs from the transmission line would be expected to be extremely intermittent and sporadic. In addition, users would generally not be close enough to the line to receive exposure to EMF levels that could pose a risk to health or safety. Implementation of the transmission line would therefore not result in significant long-term exposure of humans to health or safety risks from EMFs.

WHY THE PROPOSED PROJECT IS CURRENTLY JUSTIFIED

As discussed in Section 1.2, Purpose and Need, the proposed project is believed to be justified at this time due to the economic and social benefits of the production and transmission of geothermal power. Development of geothermal power at this time would be consistent with the current need to lessen dependence on imported fossil fuels for traditional power generation technologies. Calpine believes that there is an immediate need for these benefits, rather than reserving options for future alternatives.

There is currently a need for more stability in the BPA and Pacific Northwest power transmission system, and the proposed action would assist in providing this stability. The economic and social benefits of the proposed project would include the provision of a necessary commodity to the power industry, the production of power from a source with less environmental impacts than traditional sources, the creation of employment opportunities, and increased taxes and revenues from the project.

4.21 Significant Irreversible Environmental Changes

Both NEPA and CEQA require a discussion of any irreversible environmental changes that would occur if a proposal is implemented (40 CFR 1502.16 and CEQA Guidelines Section 15126(f)). CEQA also states that uses of nonrenewable resources during the initial and continued phases of the project may be irreversible since a large commitment of such resources makes removal or non-use thereafter unlikely, and that irreversible damage can result from environmental accidents associated with the project (CEQA Guidelines Section 15126(f)).

The proposed project would include the use of a renewable resource (geothermal fluid) at the Glass Mountain KGRA. Wellfield production operations would involve the systematic removal of geothermal fluid from the geothermal reservoir in the area, and the injection of spent fluids into the geothermal reservoir. This injection would minimize the overall effect of extraction of the geothermal resource. Based on current knowledge of the resource, it is not expected that the use of the geothermal fluids would result in any irreversible environmental changes to the geothermal reservoir (see Section 4.4, Geothermal Resources).

The proposed project would establish a transmission line corridor from the Glass Mountain KGRA to the BPA Malin-Warner transmission line. Since the USFS has stated that only one transmission line corridor will be allowed to be developed out of the Glass Mountain KGRA, development of the proposed transmission line would commit future geothermal development projects to using this corridor.

The proposed project would involve the burning of fossil fuels by construction equipment and vehicles for construction and decommissioning activities at the wellfield and power plant area, as well as along the proposed transmission line route. Fossil fuels would also be burned by project-associated vehicle use during the operation phase. This burning of fossil fuels would represent an irreversible commitment of nonrenewable natural resources for project construction and operation. The use of non-recyclable building materials during project construction would also represent an irreversible commitment of nonrenewable natural resources.

There is the potential that accidents could occur that would cause environmental effects. The potential for accidents to occur cannot be completely eliminated, and the potential for irreversible damage from environmental accidents would exist throughout the life of the project. Examples of environmental accidents include potential trucking accidents that could release hazardous materials to the environment, a downed power line along the transmission line accident that could cause a fire along the right-of-way, a well blow-out, or chemical releases at the plant site from improper storage or handling of hazardous materials. All relevant Federal, state, and local procedures would be followed during construction, operation, and decommissioning of the proposed project, and proposed mitigation would be implemented to ensure that the potential for environmental accidents associated with the project would be minimal or nonexistent.

5: MITIGATION MONITORING AND REPORTING PROGRAM

5: MITIGATION MONITORING AND REPORTING PROGRAM

5.1 Introduction

NEPA states that a mitigation monitoring and enforcement program shall be adopted for any proposed action requiring mitigation (40 CFR 1505.2(c)). In addition to this requirement under NEPA, State Assembly Bill AB 3180 was enacted by the California State Legislature in 1988 to provide a mechanism to ensure that mitigation measures adopted through the CEQA process are implemented in a timely manner and in accordance with the terms of project approval. Under AB 3180, which added Section 21081.6 to CEQA, public agencies are required to adopt a monitoring or reporting program designed to ensure compliance during project implementation. This program is required to be adopted when the public agency is making required findings after consideration of the Final EIR (Public Resources Code Section 21081.6 and CEQA Guidelines Section 15091).

Table 5.1-1 provides a proposed Mitigation Monitoring and Reporting Program (MMRP) for the proposed project and its alternatives. This MMRP outlines procedures for the implementation of mitigation measures identified in Chapter 4 of this EIS/EIR. These mitigation measures would reduce the level of impact of potential environmental effects of the proposed action. In many cases, these mitigation measures would reduce the impact of effects determined to be significant prior to mitigation to less-than-significant levels. In order to clearly identify the phase (or phases) of the project for which the mitigation measures apply, each mitigation measure has been assigned one or more of the following designations:

C = Construction phase

O = Operational phase

D = Decommissioning phase

5.2 Responsibilities of the Involved Parties

Calpine Corporation and its construction contractors must fully comply with all applicable conditions and measures described in this MMRP during construction, operation, and decommissioning of the proposed project or alternative. In some cases, mitigation measures are identified that would be the responsibility of one or more of the lead agencies for the proposed project. In these cases, the identified lead agency would be responsible for mitigation implementation. The USFS and BLM would monitor and verify compliance with the MMRP during the life of the project. The USFS would also be responsible for preparing brief mitigation compliance reports that would be kept on file by the USFS, BLM, BPA, and Siskiyou APCD.

5.3 Contents of the MMRP

The MMRP for the project (Table 5.1-1 at the end of this section) is organized in table format and is keyed to each mitigation measure identified in the EIS/EIR. The MMRP is organized by environmental issue area, and discusses only those impacts for which mitigation has been identified. The intent of formatting the MMRP as a table is to provide the reader with a concise and quick summary of the measure(s) to be implemented, agencies involved, timing of implementation, and frequency of monitoring. The purpose of each column heading is as follows:

- **Mitigation Measure:** The full text of the mitigation requirement from Chapter 4 of the EIS/EIR
- **Implementation Procedure:** Additional information on how mitigation measures will be implemented
- **Responsible Agency:** The responsible agency will be responsible for monitoring the implementation of all mitigation measures identified in the MMRP. Other agencies which will be involved with the review and approval of actions required to implement specified mitigation measures and reporting tasks are identified, as appropriate
- **Monitoring and Reporting Actions:** An outline of the appropriate monitoring and/or reporting actions required to verify implementation of measures
- **Monitoring Schedule:** A schedule for conducting each mitigation monitoring and reporting action

The mitigation listed in Table 5.1-1 applies to all development alternatives except as otherwise noted in the table.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
GEOLOGY AND SOILS				
4.2.2a Calpine shall not undertake project activities within any established or proposed Special Interest Area (SIA). Calpine shall define in the field with a USFS representative the limits of project activities and surface disturbance for facilities proposed near SIAs to ensure that inadvertent damage to SIAs does not occur. The limits of surface disturbances shall be marked by stakes and flags prior to construction. (C)	1) Calpine will use stakes and flags to mark the limits of surface disturbance near SIAs prior to construction to avoid inadvertent damage to SIAs. 2) Calpine will restrict surface disturbance to lands within the staked area and will not site any project facilities or conduct project activities within established or proposed SIAs .	USFS	1) Assist Calpine personnel in marking the limits of surface disturbance prior to construction in order to ensure that SIAs are avoided. 2) Field inspect construction near SIAs to verify that staked boundaries are not being exceeded and that surface disturbance is not occurring within SIAs.	1) Define surface disturbance limits near SIAs prior to construction. 2) Conduct field inspections during construction near SIAs.
4.2.8a If a transmission line alignment is chosen that includes segment A2, roads will not be constructed on the steep north slopes of Glass Mountain. The distance between transmission poles in this area will be maximized in order to accomplish this goal. Existing roads will be used in this area to the maximum extent possible. (C) *Does not apply to Alternatives 3, 4, 5, and 6.*	1) Calpine will design the alignment of segment A2 to avoid the steep slopes on the north side of Glass Mountain to the maximum extent possible. 2) Calpine will site the transmission poles in this area as far apart as possible to reduce the need for ground disturbance.	USFS	1) Assist Calpine personnel in designing a transmission line alignment that avoids steep slopes on the north side of Glass Mountain. 2) Conduct field inspections of the area to ensure that steep slopes are avoided. 3) Review construction drawings to verify that steep slopes will be avoided by segment A2.	Define alignment of segment A2 prior to construction.
4.2.10a Calpine shall develop a comprehensive Soil Conservation and Erosion Control Plan (SCEC) for the proposed project in consultation with the USFS and BLM prior to issuance of a permit. This plan shall describe measures to reduce erosion in all three phases of the project. In addition to the control measures already identified by Calpine, the SCEC shall include, but is not limited to, the following control measures: • Soil disturbance shall be limited to the amount necessary for construction and	1) Calpine will develop a comprehensive Soil Conservation and Erosion Control Plan (SCEC) for the proposed project. This plan will describe measures to reduce erosion in all three phases of the project. 2) Calpine will include the erosion measures in the construction specifications. 3) Calpine will ensure that the erosion measures are implemented during the appropriate phase of	USFS and BLM	1) Review and approve SCEC plan. 2) Review construction specifications to verify that erosion measures are incorporated. 3) Periodically monitor site to verify plan is in effect and is adequately controlling erosion on the project site.	1) Review and approve plan prior to issuance of an erosion control permit. 2) Monitor site on a bi-monthly basis during construction and decommissioning activities, and on a bi-annual basis during operation. 3) Require additional erosion control measure if significant soil erosion is occurring.

Key: C = Construction; O = Operation; D = Decommissioning

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
access. • Vehicular traffic associated with the project shall be restricted to access roads and construction clearings. • Grading and other surface disturbance activities shall be scheduled to avoid periods of heavy precipitation. • The time between surface disturbance and revegetation shall be minimized. • Detention basins, straw bales, or silt fences shall be used where appropriate. • Where transmission line construction occurs along steep slopes (greater than 15 percent), special soil handing measures shall be implemented, including replacing topsoil and leaving the seedbed rough and using mulch or erosion-control matting. • New access roads shall incorporate erosion-reduction measures such as water bars, outsloping, road ditches, and rock-lined drainages. • The water supply pipeline shall be monitored for leaks throughout the first construction season and removed at the end of this period. (C, O, D) If the USFS determines that significant increased soil erosion is occurring as a result of the proposed project, Calpine shall implement additional control measures as directed by the USFS.	the project. 4) Calpine will implement additional measures if the USFS determines that significant soil erosion is occurring.			
HYDROLOGY				
4.3.1a Prior to construction, Calpine shall submit for approval by the USFS and BLM a hydrologic monitoring plan for the caldera and a defined local area. This plan shall be implemented by Calpine, with the provision that other active geothermal developers be required to participate in the monitoring. The monitoring plan shall include, but not be limited to the	1) Calpine will develop a hydrologic monitoring plan for the caldera and a local area defined by the USFS. 2) Calpine shall implement the hydrologic monitoring plan by doing the following:	USFS and BLM	1) Review and approve the hydrologic monitoring plan. 2) Calpine will submit reports to the USFS with monitoring and pumping rate data. 3) Review the monitoring data and reduce allowable groundwater	1) Review and approve the hydrologic monitoring plan prior to initiating construction activities. 2) Calpine will submit baseline monitoring data to the USFS prior to initiating construction activities. 3) Calpine shall submit monthly

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
following: •Collection of baseline water quality data at Medicine Lake, Bullseye Lake, and Little Medicine Lake. •Calpine shall drill two to three monitoring wells (to the 90° F temperature level) around the wellfield that are down-gradient from the geothermal fluid production and injection wells. •The plan shall include a description of the wells and the well drilling procedures that will be used. •Monitoring shall include measurement of water levels in wells and analysis of standard drinking water quality constituents. •The plan shall include a description of the sampling and analysis schedule. •Record of groundwater pumping rates. •If groundwater contamination is detected, procedure for identifying and repairing the well that caused the contamination. Groundwater pumping rates shall be reduced if monitoring detects significant adverse impacts to water availability, and these impacts can be attributed to project pumping of local groundwater. (C, O)	• Collect baseline water quality data. • Drill three monitoring wells around the wellfield to the 90° F temperature level. • Monitor water levels in wells and perform standard drinking water quality analysis on water samples. • Maintain record of groundwater pumping rates. • Perform any other actions necessary to implement the approved hydrologic monitoring plan 3) The USFS and BLM will reduce allowable groundwater pumping rates if monitoring detects significant adverse impacts to water availability, and these impacts can be attributed to project pumping of local groundwater.		pumping rates if monitoring detects significant adverse impacts to water availability, and these impacts can be attributed to project pumping of local groundwater.	hydrologic monitoring data during all three phases of the project. 4) Review hydrologic monitoring data monthly. 5) Reduce groundwater pumping rates if monitoring detects significant impact to water availability due to the project.
4.3.2a If hydrologic monitoring detects significant adverse impacts to water quantity from the production or injection of geothermal fluids, the USFS and BLM shall require Calpine to make appropriate changes to operational procedures that will increase groundwater availability. These changes could include changes in production and injection rates and locations. (O)	1) If hydrologic monitoring detects significant adverse impacts to water quantity from the production or injection of geothermal fluids, then the USFS and BLM will direct Calpine to make operational changes to mitigate these effects. 2) Calpine will implement the specified operational procedures, as required by the USFS and BLM.	USFS and BLM	1) Review hydrologic monitoring data submitted monthly by Calpine. 2) Require changes to operational procedures if monitoring detects impacts to water quantity due to production or injection of fluids.	1) Review hydrologic monitoring data monthly. 2) Require operational changes as necessary.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.3.3a Calpine shall reseed, as recommended by USFS, all disturbed areas that will not be used (such as cut and fill slopes) after completion of the construction phase. (C)	1) Based on USFS recommendations, Calpine will reseed all disturbed areas that will not be used (such as cut and fill slopes) after completion of the construction phase. 2) Calpine will include this measure in the construction specifications as part of revegetation methods.	USFS	1) Provide directions to Calpine on where and how to reseed disturbed areas. 2) Review construction specifications to verify that this measure is incorporated. 3) Monitor the project site to verify disturbed areas are reseeded. If reseeding is affected by weather conditions (i.e. rainfall) reseeding will be repeated until stabilized and growing.	1) Review construction contractor specifications prior to construction activities. 2) During the construction phase, monitor the site bi-monthly and provide further recommendations to Calpine on where and how to reseed disturbed areas. 3) Following completion of construction activities, monitor the site to ensure reseeding has occurred in disturbed areas.
4.3.3b Calpine shall temporarily store excess runoff in well pad sumps or inject it into the geothermal system via injection wells. (C)	1) Calpine will temporarily store excess runoff in well pad sumps or inject it into the geothermal system via injection wells. 2) Calpine will include this measure in the construction specifications as part of revegetation methods.	USFS	1) Review construction specifications to verify that this measure is incorporated. 2) Monitor the site during construction activities to verify excess runoff is stored or injected in the designated locations.	1) Review construction contractor specifications prior to construction activities. 2) Monitor the site bi-monthly during construction activities.
4.3.3c Calpine shall place drains or energy dissipaters at intervals along new access roads to allow water greater opportunities to exit the roadbed and percolate into the native soils, and prevent the discharge of large volumes of runoff at a few points along the road. (C)	1) Calpine shall place drains or energy dissipaters at intervals along new access roads. 2) Calpine will include this measure in the final design and construction specifications as part of revegetation methods.	USFS	1) Review the design plans and construction specifications to verify these runoff control devices are included. 2) Inspect new access roads to verify that this measure has been implemented.	1) Review plans prior to approval of final design plans. 2) Inspect new access roads during the construction phase.
4.3.3d Calpine shall monitor new non-bladed roads for impacts to vegetation and increased runoff and erosion. If substantial impacts occur, Calpine shall implement corrective actions. These measures could include construction of energy dissipaters, berms or culverts, or other appropriate runoff diversion structures. (C)	1) Calpine will monitor new non-bladed roads for impacts to vegetation and increased runoff and erosion. 2) If impacts occur, Calpine will take corrective actions (i.e., the construction of energy dissipaters, berms or culverts, or other appropriate runoff diversion structures).	USFS	1) Periodically inspect new non-bladed roads for impacts to vegetation and increased runoff and erosion. 2) If impacts occur, review corrective actions taken by Calpine.	1) Inspect new non-bladed roads bi-monthly during the construction phase. 2) Require corrective measures, as necessary throughout the construction period.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.3.3e Calpine shall seed and plant, as recommended by USFS, the area of the transmission line right-of-way disturbed during construction with low-growing native plants to provide soil stabilization. Seeding and planting shall occur before the next growing season after construction. Native plants that naturally revegetate (such as resprouting shrubs) should be utilized to the fullest extent possible. This mitigation measure shall be consistent with Mitigation Measure 4.7.1d.(C)	1) The USFS will direct Calpine on how to reseed and plant the transmission line right-of-way with low-growing native plants if such plants do not naturally revegetate the area within three years. 2) Calpine will seed and plant the transmission line right-of-way with low-growing native plants before the next growing season after construction if such plants do not naturally revegetate the area.	USFS	1) Inspect the transmission line right-of-way in order to identify areas that have not naturally reseeded. 2) Direct Calpine as to the type of vegetation and seeds to use in reseeding the transmission line right-of-way. 3) Inspect reseeded areas to verify that seeding was successful. 4) Ensure that the implementation of this mitigation is consistent with Mitigation Measure 4.7.1d.	1) Inspect the transmission line right-of-way three years after completion of the construction of the transmission line. 2) Provide Calpine with recommendations for reseeding within two months of inspecting the transmission line. 3) Inspect reseeded areas following summer.
4.3.5a Calpine shall not site transmission line structures and access roads within Riparian Reserves, as delineated by the USFS. For streams located outside of Riparian Reserve areas, Calpine shall not site transmission line structures and access roads (except road crossings) within 100 feet of intermittent stream channels. (C)	1) Calpine will adjust the transmission line route to avoid Riparian Reserves, as delineated by the USFS. 2) For intermittent streams not located within a Riparian Reserve, Calpine shall adjust the transmission line route so that it does not pass within 100 feet of an intermittent stream.	USFS	1) Delineate Riparian Reserves within 200 feet of the transmission line route. 2) Review final transmission line route plans to verify compliance with mitigation measure. 3) Inspect the transmission line route as staked prior to construction to verify compliance with the mitigation measure.	1) Delineate the Riparian Reserve areas prior to approval of the final route plans. 2) Review and approve the final transmission line route plans. 3) Inspect the transmission line route after it has been staked, but prior to construction.
4.3.5b Calpine shall ensure that vehicular traffic in intermittent stream channels is minimized.(C, O, D)	1) When possible, Calpine will prohibit vehicle traffic in intermittent stream channels. 2) This measure will be incorporated into the construction specifications.	USFS	1) Review construction specifications to ensure measure is incorporated. 2) Monitor project activities to verify vehicular traffic in intermittent stream channels minimized.	1) Monitoring will occur periodically during the construction, operation, and decommissioning phases.
4.3.6a If a high volume of drilling mud is lost to the formation, the drilling contractor shall use Lost Circulation Material (LCM) to seal the well and reduce the migration of drilling mud into the formation. LCM can include constituents such as cottonseed hulls, wood chips, sawdust , etc. Alternatively, the contractor	1) Calpine's drilling contractor will monitor the drilling process to determine if a high volume of drilling mud is lost to the formation. 2) If a high volume of drilling mud is lost to the formation, the drilling	BLM	1) Review the contractor specifications to verify this measure has been incorporated. 2) Perform on-site monitoring of drilling procedures to verify these measures are implemented.	1) Review the contractor specifications prior to commencement of drilling. 2) Monitor the drilling process at least twice during the construction phase.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
shall use air, foam or aerated mud instead of LCM to reduce the lost circulation. This technique would reduce lost circulation by reducing pressure in the hole. (C)	contractor shall use Lost Circulation Material (LCM) to seal the well and reduce the migration of drilling mud into the formation. 3) This measure will be included in the drilling contractor's formal contract/specifications.			
4.3.6b The BLM shall require Calpine to periodically test the mechanical integrity of the wells to reduce the potential for failure of the well casings. Tests results shall be submitted to the BLM. (O)	1) BLM will require periodic testing of the mechanical integrity of the well casings as part of project approval. 2) Calpine will submit results from mechanical testing of well casings to the BLM.	BLM	1) Include periodic testing of the mechanical integrity of the well casings as part of Calpine's operating permit. 2) Review test reports submitted by Calpine.	1) Periodic testing of the mechanical integrity of the well casings will be included in Calpine's operating permit prior to project approval. 2) Review test reports within one month of receiving them from Calpine.
4.3.6c The Calpine Emergency Contingency Plan shall define control and restoration measures to be implemented in the event of a sump overflow, pipeline rupture, or well blowout. (C, O)	1) Calpine will develop an Emergency Contingency Plan that will define control and restoration measures to be implemented in the event of a sump overflow, pipeline rupture, or well blowout.	USFS	1) Review and approve Calpine's Emergency Contingency Plan to ensure control and restoration measures are identified in the plan for events such as sump overflow, pipeline rupture, or well blowout.	1) Review and approve Calpine's Emergency Contingency Plan prior to construction activities.
GEOTHERMAL RESOURCES				
4.4.2a The injection program shall be designed to avoid interference with temperature or chemical characteristics of production fluids as a result of injecting waste fluids. (C, O)	1) Calpine shall design the injection program to avoid interference with temperature or chemical characteristics of production fluids as a result of injecting waste fluids.	BLM	1) Review production and injection well siting and design plans to verify this measure has been implemented. 2) Monitor drilling reports for changes in the temperature or chemical characteristics of produced geothermal fluids.	1) Review design plans prior to well drilling activities. 2) During operation activities, review geothermal data reported by Calpine to detect any changes in the temperature or chemical characteristics of produced geothermal fluids.
CULTURAL RESOURCES				
4.5.1a To comply with Federal requirements pertaining to cultural resources, a qualified archaeologist (on behalf of Calpine) shall survey, identify, and record cultural resources within the proposed transmission line corridor and where ground disturbance outside of the corridor would occur due to access roads,	1) Calpine will hire a qualified archaeologist to survey, identify, and record cultural resources within the proposed transmission line corridor and where ground disturbance outside of the corridor would occur due to access roads, lay-down areas, and	USFS	1) Review cultural resources survey report submitted by Calpine to verify that cultural resources will be avoided. If sites cannot be avoided, review plan for testing evaluation and data recovery. 2) Inspect transmission line	1) Review cultural resources survey report prior to any surface disturbing activities. 2) Inspect transmission line corridor bi-monthly and access roads during the construction phase.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
lay-down areas, and other associated sites. The survey shall be conducted prior to the commencement of surface disturbing activities for the proposed project. Preliminary construction plans should be overlaid on the cultural resources base maps to identify where surface disturbance will likely occur that may impact a cultural resource. Transmission facilities shall be relocated to avoid historic and prehistoric sites where possible and practical. If avoidance is not feasible, it will be necessary to evaluate each potentially affected site in order to determine if the site is eligible for listing under NRHP criteria. Evaluation of prehistoric sites may include some amount of surface collection and subsurface excavation; evaluation of historic sites may include focused archival study, field recordation, and/or surface collections and subsurface probing as part of data or resource recovery methods. (C)	other associated sites. 2) Calpine will overlay preliminary construction plans on the cultural resources base maps to identify where surface disturbance will likely occur. 3) Calpine will avoid historic and prehistoric sites by locating the line around sites. If not possible, then, evaluate sites to determine eligibility (see mitigation measure for potential evaluation methods). 4) Calpine will submit a report outlining survey methods and findings, and detailing any necessary modifications of the transmission line route. This report shall also include cultural resource base maps.		corridor and access roads during construction to verify that cultural resources are being avoided.	
4.5.1b At sites already determined eligible, prior evaluation and mitigation efforts (where conducted) shall be thoroughly reviewed to better assess the effects that this undertaking will have on the property, prior to construction activities. An effort shall be made to relocate transmission facilities, where possible and practical, so that impacts are restricted to areas previously mitigated within eligible properties and remaining intact deposits are not affected. At some eligible sites, it may be necessary to evaluate deposits within the right-of-way to determine the appropriate course of action, as determined by a qualified archaeologist or cultural resource specialist. At historic sites, evaluation may include archival study and/or field recordation. (C)	1) Calpine will hire a qualified archaeologist to thoroughly review the effects that this project will have on the properties that have previously been determined as eligible. 2) Calpine will relocate transmission facilities, where possible and practical, so that impacts are restricted to areas previously mitigated within eligible properties and remaining intact deposits are not affected. 3) If necessary, Calpine will hire a qualified archaeologist to evaluate archaeological deposits within the right-of-way and determine the appropriate course of action. Actions may include avoidance or data recovery.	USFS	1) Review assessment of impacts to properties that have been previously determined as eligible. 2) Review transmission line design plans to verify that transmission facilities are restricted to areas previously mitigated within eligible properties, when possible and practical. 3) Review recommendations of archaeologist regarding the evaluation of archaeological deposits within the right-of-way.	1) Review the cultural resources information and recommended actions prior to construction.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.5.1c Avoid cultural resources wherever possible. To ensure that construction activities do not encroach on cultural resources slated for avoidance, sensitive areas shall be flagged prior to surface-disturbing activities, supervisory construction personnel shall be briefed on these locations (and the consequences of encroachment). And, the areas shall be monitored once every week during construction activities by a qualified archaeologist to ensure sites are protected/avoided. (C)	1) Calpine will flag sensitive areas to be avoided prior to surface-disturbing activities. 2) Calpine will brief supervisory construction personnel regarding these locations and the consequences of encroachment. 3) Calpine will hire a qualified archaeologist to monitor sites once weekly during construction to ensure sensitive areas are protected/avoided. 4) Calpine will include this measure in construction specifications.	USFS	1) Review construction specifications prior to final approval. 2) Inspect site to verify that sensitive areas have been properly flagged. 3) Monitor site once weekly to verify sensitive sites are avoided.	1) Review construction specifications prior to final approval and before initiation of construction activities. 2) Inspect site to ensure that sensitive areas have been properly flagged prior to surface disturbing activities. 3) Monitor site once weekly during construction to ensure sensitive sites are avoided.
4.5.1d Construction activities and the production/injection line shall be routed a minimum of 100 feet from the northern boundary of the prehistoric quarry identified at the power plant site. The construction area shall be defined and flagged, with a USFS representative and a cultural resource specialist or archaeologist in attendance, prior to construction. If avoidance is not feasible, the resource specialist shall evaluate the prehistoric site to determine if it is eligible for listing on the NRHP. If it is eligible, data recovery methods, such as collecting surface and subsurface resources shall be pursued as determined by the resource specialist. In addition, it is recommended that no evaluation of the historic site identified at the wellfield and power plant site be undertaken, provided that the proponent's use of USFS Road 44N64 remains as a roadway and does not involve any surface disturbance or subsurface activities, such as grading or excavation adjacent to the roadway. (C)	1) Calpine, with USFS representative and qualified archaeologist or cultural resource specialist, will flag the construction limits of construction activities at a minimum of 100 feet from the northern boundary of the prehistoric quarry identified at the power plant site. 2) If the site cannot be avoided, the resources specialist will determine if the site is eligible for listing on the NRHP. 3) If eligible, data recovery methods shall be pursued by the resource specialist.	USFS	1) Ensure that route is a minimum of 100 feet from the northern boundary of the prehistoric quarry identified at the power plant site. 2) Define and flag site, with a USFS representative and a cultural resource specialist or archaeologist in attendance. 3) If not avoidable, determine if site is eligible, see mitigation measure for details on evaluation.	1) Prior to construction activities, review construction design specifications 2) Prior to construction activities, define and flag site and take additional steps as deemed necessary by the specialist.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.5.1e Construction workers and other persons directly involved with on site activities for the proposed project, including maintenance crews, shall be informed of the sensitivity of the area for cultural resources, and instructed to refrain from unauthorized prehistoric and historic resource collection. All construction workers and other persons directly involved with on-site activities for the proposed project shall be required to sign an agreement recognizing the fragile nature of prehistoric resources and acknowledging that unauthorized collection of said resources is a crime. (C)	1) Calpine will inform workers of the sensitivity of the area for cultural resources. 2) Calpine will instruct workers to refrain from unauthorized prehistoric and historic resource collection. 3) Calpine will have workers sign an agreement recognizing the fragile nature of prehistoric resources and acknowledging that unauthorized collection of said resources is a crime. 4) Calpine will include this measure in the construction specifications.	USFS	1) Review construction specification to verify this measure is incorporated. 2) Review copies of agreements signed by construction workers recognizing the fragile nature of prehistoric resources and acknowledging that unauthorized collection of said resources is a crime.	1) Review specifications prior to approval and the beginning of construction. 2) Review copies of agreements signed by construction workers prior to surface disturbing activities.
4.5.1f If prehistoric archaeological resources are discovered during construction, all work in the immediate vicinity shall be suspended pending site investigation by the USFS and a qualified archaeologist to assess the materials and determine their significance. After halting construction in the area that previously undiscovered resources are found, the resource will be recorded and it will be determined if the project could be re-routed to avoid any additional effects. If avoidance is not feasible, the site will be evaluated by a qualified archaeologist and a determination of eligibility for the NRHP shall be made. If the site is determined to be eligible, then a mitigation proposal (which may include a data recovery program similar to those conducted for similar resources in the vicinity) shall be submitted with the site record to the Office of Historic Preservation (OHP) for review and concurrence. (C)	1) Calpine will halt construction activities in the event that an unidentified prehistoric archaeological resource is discovered. 2) Calpine will walk the site with USFS representative and a qualified archaeologist to assess the materials and determine their significance. 3) If possible, Calpine will avoid site. 4) If the site cannot be avoided, Calpine will hire a qualified archaeologist to determine the eligibility of the site for listing on the NRHP. If the site is determined eligible, then a mitigation proposal, approved by the USFS, will be submitted to OHP for approval. 6) Calpine will include this measure in the construction specifications.	USFS	1) Review construction specifications to verify this measure is incorporated. 2) If site is found, inspect site to assess materials and determine their significance. 3) If site cannot be avoided and is determined to be eligible, assist Calpine in preparing a mitigation proposal to submit to OHP. 4) Ensure mitigation plan is appropriately implemented.	1) Review specifications prior to approval and the beginning of construction. 2) Inspect and assess site immediately after archaeological resources are discovered. 3) Assist in preparation of mitigation proposal after site has been determined as eligible. 4) Ensure mitigation plan is appropriately implemented, prior to the allowing construction to continue.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.5.1g If prehistoric archaeological deposits that include human remains or objects considered "cultural items" according to the Native American Graves Protection and Repatriation Act are discovered during construction, the County Coroner and a qualified archaeologist shall be notified immediately and NAGPRA regulations shall be followed. If the remains are identified as American Indian, the tribe(s) shall be notified within one (1) working day and consultation will be initiated. Project activities may resume 30 days after notifying the tribe(s). Repatriation of the other categories of items (funerary objects, sacred objects, and cultural patrimony) shall be based on evidence that indicates whether or not the original acquisition of the object was from an individual that had the authority to separate the item from the tribal group. (C)	1) Calpine will halt construction activities in the event that human remains or a "cultural item," as defined by NAGPRA, is discovered. 2) Calpine will notify the County Coroner and a qualified archaeologist immediately and will follow NAGPRA regulations. 3) If remains are of American Indians, the USFS will notify tribes within one (1) working day and will initiate consultation. 4) Calpine will include this measure in the construction specifications.	USFS	1) Review construction specifications to verify this measure is incorporated. 2) Monitor construction activities to verify that if human remains or cultural items are found, and that this measure is being implemented.	1) Review specifications prior to the beginning of construction. 2) Monitor construction activities monthly throughout the construction phase.
4.5.1h If avoidance of previously undiscovered prehistoric archaeological resources is not be feasible, an evaluation of the resources shall be required and conducted by a qualified archaeologist or cultural resources specialist. An evaluation plan would be developed by the archaeologist and would consist of the methodical excavation of those portions of the site(s) that would be adversely affected. Only a qualified archaeologist or cultural resources specialist shall be allowed to collect any prehistoric resources discovered at the site. The work shall be accomplished within the context of a detailed research design and in accordance with current professional standards. The plan shall result in the extraction of sufficient volumes of non-redundant archaeological data so as to address important regional research	1) Calpine will have a qualified archaeologist or cultural resources consultant evaluate resources that can not be avoided. 2) Calpine's consultant will develop an evaluation plan and include methodical excavation of those portions of the site(s) that would be adversely affected. 3) Calpine's consultant will collect any prehistoric resources discovered at the site. (done by qualified archaeologist or cultural resources consultant). 4) USFS will ensure that work for the evaluation plan will be conducted within the context of a detailed research design and in accordance with current	USFS	1) Review construction specifications to verify this measure is incorporated. 2) Review and approve evaluation plan if one needs to be prepared. 3) Monitor archaeological collection activities to verify that evaluation plan is being properly implemented. 4) Review technical reports that document any findings.	1) Review specifications prior to the beginning of construction. 2) Review and approve evaluation plan within two weeks of submittal. 3) Periodically monitor archaeological collection activities (if they occur).

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
consideration, detailed technical reports shall be prepared to document the findings. (C)	professional standards. The plan should result in the extraction of sufficient volumes of non-redundant archaeological data so as to address important regional research consideration. 5) Calpine will prepare detailed technical reports to document the findings. 6) Calpine will include this measure in the construction specifications.			
4.5.1i Maintenance and emergency plans to be developed by Calpine and required for project operation shall include maps of cultural resources that clearly outline site boundaries. Project maintenance and emergency plans shall ensure that successful implementation of these activities can occur without the encroachment of cultural resource sites. (O)	1) Calpine will include confidential maps of sensitive cultural resources that clearly outline significant site boundaries in maintenance and emergency plans developed for the project. 2) Calpine will ensure that successful implementation of these maintenance and emergency activities can occur without the encroachment of cultural resource sites.	USFS	1) Review maintenance and emergency plans. 2) Inspect project activities to verify that cultural resource sites are not being encroached upon.	1) Review maintenance and emergency plans prior to surface disturbing activities. 2) During construction and decommissioning, inspect project sites on a monthly to ensure that cultural resources are not being encroached upon. During operation, inspect project sites quarterly.
4.5.1j Plans for project operation shall ensure that spills of hazardous material or geothermal fluids are rapidly contained so that cultural resource sites are not affected in the case of such an event. (O)	1) Calpine will develop plans for spills of hazardous material or geothermal fluids which ensure that these materials will be rapidly contained so that cultural resource sites area not affected.	USFS	1) Review spill containment plans to verify that cultural resource sites will be protected. 2) Monitor project activities to verify that cultural resource sites are not being impaired by spills of hazardous materials or geothermal fluids.	1) Review spill containment plans prior to construction. 2) Monitor project activities periodically during the operation phase.
TRADITIONAL CULTURAL VALUES				
4.6.2a The proposed transmission line shall be rerouted to avoid traditional-use sites. The appropriate local tribes shall be consulted for location and aerial extent of sites prior to the commencement of construction activities. (C)	1) Calpine and the USFS will consult with local tribes for location and aerial extent of traditional-use sites. 2) Calpine will reroute transmission lines to avoid traditional-use sites.	USFS	1) Review final transmission line design plans to verify that traditional-use sites are avoided. 2) Inspect transmission line corridor to verify that traditional-use sties are avoided.	1) Review final transmission line plans prior to construction. 2) Inspect the transmission line corridor bi-monthly during construction activities.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.6.3a Calpine shall designate an authorized representative who may be contacted by tribal members during construction to determine activity schedules; this would reduce the potential for interference with tribal activities in the project area during construction. The Calpine representative's name and telephone number shall be provided during the annual project schedule update. (C, O, D)	1) Calpine will designate an authorized representative who may be contacted by tribal members during construction to determine activity schedules. 2) Calpine will provide the representative's name and telephone number during the annual project schedule update. 3) Calpine will notify USFS and BLM if contacted by tribal members. Calpine will accommodate tribal concerns where feasible and practicable.	USFS	1) Verify that Calpine has designated a representative who may be contacted by tribes and that this person's name and phone number is included with the annual project schedule update. 2) Review and discuss tribal requests with Calpine and/or the tribes.	1) Prior to construction activities, designate an authorized representative who may be contacted. 2) Provide the Calpine representative's name and telephone number during the annual project schedule update. 3) Calpine or the USFS or BLM shall respond to the tribal requests within 30 days.
4.6.3b Prior to the commencement of construction activities, Calpine and the USFS shall consult with the appropriate local tribes to determine which sites of tribal concern should be evaluated for noise effects. A monitoring program shall be defined that would determine actual project-related noise levels (with monitoring during drilling and power plant operation). Rescheduling certain project activities and use of temporary noise shields to minimize effects also may be considered. (C, O)	1) Prior to the commencement of construction activities, Calpine and the USFS will consult with the appropriate local tribes to determine which sites of tribal concern should be evaluated for noise effects. 2) Calpine will establish a monitoring program that would determine actual project-related noise levels (with monitoring during drilling and power plant operation). This program will be approved by the USFS. 3) Calpine may consider rescheduling certain project activities to minimize effects.	USFS	1) Review and approve monitoring program. 2) Review noise monitoring reports submitted by Calpine.	1) Review and approve monitoring program prior to commencement of construction activities. 2) Review noise monitoring reports during construction phase.
4.6.7a Prior to the commencement of the project construction activities, Calpine shall make a specific outreach to local tribes for hiring for both construction and plant operation jobs A similar outreach shall be made prior to decommissioning activities. (C, O, D)	1) Calpine will make a specific outreach to local tribes for hiring for both construction and plant operation jobs. A similar outreach will be made prior to decommissioning activities.	USFS	1) Review employment outreach efforts made by Calpine.	1) Review employment outreach efforts prior to construction activities, and again prior to decommissioning activities.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
VEGETATION				
4.7.1a Vegetation loss shall be kept to a minimum during the construction of the project. Facilities shall be sited in areas of previous disturbance, such as log decks, wherever possible. During all construction, tree removal shall be kept to a minimum; removal of trees with a dbh greater than or equal to 18 inches shall also be minimized. The impact to late seral stage forest shall be minimized by skirting stands of forest, such as red fir, to the greatest extent possible. In addition, the freshwater pipeline shall be placed between trees, and shall avoid the need to clear timber. (C)	1) Calpine will site facilities in areas of previous disturbance, such as log decks, wherever possible. 2) Calpine will keep tree removal to a minimum, especially trees with a dbh greater than or equal to 18 inches. 3) Calpine will skirt stands of forest, such as red fir, to the greatest extent possible. 4) Calpine will place the temporary freshwater pipeline between trees, reducing the need to clear timber.	USFS	1) Field inspect and review the location of wellfield facilities and the routing of the transmission line and temporary freshwater pipeline in order to ensure that vegetation loss is minimized. 2) Record areas of late seral stage forest and trees with a dbh greater than or equal to 18 inches, and document the amount that is avoided and the amount that would be affected.	1) Prior to construction activities.
4.7.1b For loss of late seral stage forest and trees and snags with a dbh greater than or equal to 18 inches, Calpine shall be responsible for providing compensation since this loss will result in loss of habitat for certain special-status wildlife species. Compensation shall be provided as discussed under impact 4.8.1 in Section 4.8—Wildlife. (C)	1) Calpine and the USFS will determine the loss of late seral stage forest and trees and snags with a dbh greater than or equal to 18 inches. 2) Calpine will coordinate with the USFS to determine the amount and appropriate type of compensation required, to identify appropriate sites for compensation, and will provide compensation.	USFS	1) Conduct field review to identify and record areas of late seral stage forest and trees with a dbh greater than or equal to 18 inches that would be affected. 2) Upon determination of the amount and appropriate type of compensation required, document this information. 3) Field inspect compensation to ensure that compensation is provided, and record results of field inspection.	1) Identify and document affected areas of late seral stage forest and trees with a dbh greater than or equal to 18 inches prior to commencement of construction activities. 2) Field inspect compensation upon completion of the provision of compensation.
4.7.1c Roads and wellpads shall be sited to minimize cut and fill and fill slopes shall be constructed at no greater slope than 1.5:1. Standard erosion control measures shall be implemented where appropriate, such as construction of water bars on roads, and check dams and energy dissipaters as needed. (C)	1) Calpine will site roads and wellpads to minimize cut and fill. 2) Calpine will construct fill slopes at no greater slope than 1.5:1. 3) Calpine will implement standard erosion control measures, such as construction of water bars on roads, and check dams and energy dissipaters as needed. 4) Calpine will include this	USFS	1) Review final design plans and construction specifications to ensure that construction is conducted in accordance with this mitigation measure. 2) Field inspect construction to verify that measure is being implemented.	1) Review design plans prior to construction. 2) Inspect construction sites bi-monthly during construction to ensure that measure is being implemented.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
	measure in final design plans and construction specifications.			
4.7.1d During construction of wellpads, the top 6 inches of surface soil shall be stockpiled separately for application onto the fill slopes. Following construction and decommissioning, a revegetation plan shall be prepared for the revegetation of the transmission line, wellpads, pipelines, and power plant site, under the direction of the USFS. The revegetation plan shall include the use of currently accepted practices and plant materials. Areas cleared within the transmission line right-of way shall be seeded or planted with native perennial grasses and low growing shrubs such as ceanothus, manzanita, and bitter brush. The selection of plant materials will be based on site conditions and will approximate the species composition of nearby successional areas. (C, D)	1) Calpine will stockpile the top 6 inches of surface soil at the wellpads separately for application onto fill slopes. 2) Calpine will prepare and implement a revegetation plan for the revegetation of the transmission line, wellpads, pipelines, and power plant site, under the direction of the USFS.	USFS	1) Inspect well pads during construction to ensure that soil is stockpiled. 2) Assist in the development of the revegetation plan for the revegetation of the transmission line, wellpads, pipelines, and power plant site; keep this revegetation plan file on file at the USFS. 3) Inspect revegetated areas after implementation of the revegetation plan.	1) Inspect well pads during construction to ensure that soil is stockpiled. 2) Following construction and decommissioning, develop a revegetation plan, and keep this revegetation plan on file at the USFS after completion of this plan. 3) Inspect revegetated areas after implementation of the revegetation plan.
4.7.2a Calpine shall develop and implement a monitoring plan in coordination with the USFS to document the deposition impacts to vegetation in the vicinity of the power plant resulting from project operation. The plan shall include the following: • Periodic (i.e., quarterly) chemical analysis of circulating water to ascertain the concentration of boron, mercury, and arsenic. • An annual evaluation of the effect of cooling tower drift on nearby trees in the vicinity of the power plant. Assessment may be a semi-quantitative assessment of leaf damage, but may also include chemical analysis of damaged leaves. • If tree mortality occurs in close proximity to the power plant site and it is determined that this mortality is due	1) Calpine will develop and implement a monitoring plan in coordination with the USFS to confirm insignificant deposition impacts. 2) Calpine will provide periodic (i.e., quarterly) chemical analysis and annual evaluation of the effect of cooling tower drift on nearby trees in the vicinity of the power plant to the USFS. 3) If tree mortality occurs as a result of project deposition, compensate for this effect as directed by the USFS.	USFS	1) Assist in the development of the monitoring plan to confirm insignificant deposition impacts. 2) Review the periodic chemical analysis and annual evaluation of the effect of cooling tower drift on nearby trees in the vicinity of the power plant. 3) If project deposition effects occur, coordinate with Calpine regarding the need for any vegetation compensation due to project deposition, and field inspect and verify the provision of this compensation.	1) Assist in the development of the deposition monitoring plan prior to project operation. 2) Review the periodic chemical analysis on a quarterly basis, and review the evaluation of the effect of cooling tower drift on nearby trees in the vicinity of the power plant on an annual basis. 3) If project deposition effects occur, coordinate as needed with Calpine during project operation, and field inspect and verify the compensation after it has been provided.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
to the emissions of and deposition from the proposed project, revegetation shall be carried out by Calpine (as directed by the USFS) to compensate for these effects. This compensation could involve replanting more tolerant indigenous vegetation such as grass and shrubs in the power plant vicinity, providing off-site replacement vegetation, and/or enhancing other vegetated areas as directed by the USFS. (O)				
4.7.3a Early summer floristic surveys and preconstruction surveys of the proposed transmission line route and the wellfield and power plant area shall be carried out. Currently-identified populations of special-status species (particularly Hall's sedge, sugar stick, gray penstemon, and volcanic daisy populations) shall be marked and avoided. Detailed surveys for additional special-status species shall be carried out and populations marked and avoided. Populations of CNPS List 1 and 2 plants and Category 2 plants listed in the Northwest Forest Plan shall be avoided with sufficient buffer to protect the population. Where possible, other special-status plant species, such as CNPS List 3 and 4, USFS Special Interest, and Presidents Forest Plan Category 3 and 4 species shall be avoided where possible. (C)	1) Calpine will conduct floristic surveys and preconstruction surveys of the proposed transmission line route and the wellfield and power plant area. 2) Calpine will mark and avoid currently-identified populations of special-status species (particularly Hall's sedge, sugar stick, gray penstemon, and volcanic daisy populations). 3) Calpine will mark and avoid any special-status species identified during floristic surveys and preconstruction surveys.	USFS	1) Ensure that floristic surveys and preconstruction surveys are conducted prior to construction activities. 2) Field review the project prior to construction to ensure that special-status species are marked and avoided.	1) Ensure that floristic surveys and preconstruction surveys are conducted prior to construction activities. 2) Field review the project prior to construction.
4.7.3b Maintenance plans and emergency access plans shall include maps of special status species in the area that must be avoided. (O)	1) Calpine will include special-status species to be avoided in maintenance plans and emergency access plans.	USFS	1) Review maintenance plans and emergency access plans to ensure that special-status species to be avoided are identified.	1) Review maintenance plans and emergency access plans prior to construction.
4.7.4a In order to avoid the meadow north of Medicine Lake, the portion of segment A1 of the transmission line corridor near the meadow shall be relocated to be routed north of this meadow, between the meadow and the	1) Calpine will locate the portion of segment A1 near the meadow at Medicine Lake to be routed north of this meadow and its 150-foot buffer zone, between the meadow	USFS	1) Conduct field review to assist Calpine in ensuring that the portion of segment A1 near the meadow at Medicine Lake and associated access roads are not located in this meadow and its 150-	1) Conduct field review to assist Calpine prior to construction. 2) Review construction plans prior to construction.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
Medicine Lake Glass Flow. The transmission line at this location shall be constructed to avoid the meadow and its 150-foot Riparian Reserve buffer zone by ensuring that the transmission line poles are located such that the transmission line spans any portion of the meadow or its buffer zone underneath the line. Access roads shall not be located in the meadow area or in its buffer zone, and construction activities shall avoid this meadow and its buffer zone. (C) *Does not apply to Alternatives 5 and 6.*	and the Medicine Lake Glass Flow. 2) Calpine will not locate access roads in the meadow area or in the 150-foot buffer zone.		foot buffer zone. 2) Review construction plans to ensure that the portion of segment A1 near the meadow at Medicine Lake is routed to the north of the meadow and its 150-foot buffer zone, and that access roads are not located in the meadow and its buffer zone. 3) Field inspect construction to ensure that the meadow and its buffer zone at Medicine Lake are avoided.	3) Perform field inspections during construction to ensure that the meadow at Medicine Lake is avoided.
4.7.4b The dispersed, small potential wetland areas along segment C1 or C2 of the transmission line shall be avoided. A qualified biologist shall delineate the extent of these potential wetland areas prior to construction, and transmission line facilities shall be sited to avoid these areas. Habitat disturbance in areas other than potential wetland habitat shall be minimized, and construction activities shall be timed to avoid periods of wet weather in which habitat disturbance (e.g., soil erosion and compaction) may be greater. Access roads and support structures for this portion of segment C1 or C2 shall be placed in uplands. (C)	1) Calpine will ensure that a qualified biologist will delineate the extent of potential wetland areas prior to construction. 2) Calpine will site transmission line facilities to avoid potential wetland areas, will minimize habitat disturbance, and will locate access roads in upland areas. 3) Calpine will time construction activities in the vicinity of potential wetland areas to avoid wet periods in which habitat disturbance may be greater.	USFS	1) Ensure that a qualified biologist is retained by Calpine to delineate the extent of potential wetland areas. 2) Review construction plans to ensure that potential wetland areas are avoided by project facilities. 3) Monitor project construction to ensure that construction activities do not occur in the vicinity of potential wetland areas during wet periods.	1) Ensure that a qualified biologist is retained by Calpine prior to construction. 2) Review construction plans prior to construction. 3) Perform field inspections during construction to ensure that construction activities do not occur in the vicinity of potential wetland areas during wet periods.
4.7.4c All vehicular activity shall be restricted to existing roads and new roads, and all new roads shall be constructed only in upland areas. (C, O, D)	1) Calpine will restrict all vehicular activity to existing roads and new roads, and will construct new roads only in upland areas. 2) Calpine will include this measure in construction specifications.	USFS	1) Review construction plans to ensure that all new roads will be constructed only in upland areas. 2) Periodically inspect construction to ensure that all new roads are being constructed only in upland areas. 3) Monitor vehicular activity to ensure that vehicles use only existing roads and new roads.	1) Review construction plans prior to construction. 2) Inspect road construction periodically throughout the construction period. 3) Monitor vehicular activity throughout project construction, operation, and decommissioning.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.7.5a Calpine shall develop and implement a weed control plan under the direction of the USFS. This plan shall be modeled on the plan for the Tuscarora natural gas pipeline project segment on the Modoc National Forest, and shall include the following elements: • Development of a list of weeds for which control measures are required. • An inventory of existing weed infestations within the project area. • Wash stations for construction vehicles entering the project area and at staging areas along the transmission line route. • Post-construction monitoring and control of weed infestations that will occur periodically throughout the life of the project, under the direction of the USFS. (C, O, D)	1) Calpine will develop a weed control plan under the direction of the USFS. 2) Calpine will implement the weed control plan, as directed by the USFS.	USFS	1) Assist in the development of the weed control plan. 1) Monitor the implementation of the weed control plan to ensure that all measures are enacted. 3) Periodically inspect activities to ensure Calpine compliance with the weed control plan.	1) Assist in the development of the weed control plan prior to construction. 1) Monitor the implementation of the weed control plan at the initiation of construction activities to ensure that all measures are enacted. 3) Periodically inspect activities throughout project construction, operation, and decommissioning to ensure Calpine compliance.
WILDLIFE				
4.8.1a Vegetation management activities should use selective methods during construction. Selective methods, such as scalloping or clearance, should be used to trim or remove only vegetation with potential to interfere with construction of the transmission line. (C)	1) Calpine will use selective vegetation management methods to minimize vegetation removal during construction. Methods shall be consistent with the mitigation measures in Section 4.7.	USFS	1) Review and approve selective vegetation management methods to ensure vegetation removal is minimized during construction. 2) Field inspect construction to verify that measure is being implemented.	1) Review and approve selective vegetation management methods prior to construction. 2) Inspect construction sites monthly during construction to ensure that measure is being implemented.
4.8.1b Vegetation management activities should use selective methods during operation. Selective methods, such as scalloping or clearance, should be used to trim or remove only vegetation with potential to interfere with transmission line operation. (O)	1) Calpine will use selective vegetation management methods to minimize vegetation disturbance during operation. Methods shall be consistent with the mitigation measures in Section 4.7.	USFS	1) Review and approve selective vegetation management methods to ensure vegetation disturbance is minimized during operation. 2) Field inspect during periods of vegetation management to verify that measure is being implemented.	1) Review and approve selective vegetation management methods prior to operation. 2) Inspect during periods of vegetation management during operation to ensure that measure is being implemented.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.8.1c Minimize the removal of late seral stage forest and individual trees and snags with dbh greater than or equal to 18 inches during construction of the transmission line by locating transmission line facilities in areas such as log decks, previously logged forest stands, and areas of small class-size trees (i.e., smaller than 18 inches dbh), wherever possible. (C)	1) Calpine will site facilities in areas of previous disturbance, such as log decks, wherever possible. 2) Calpine will keep tree removal to a minimum, especially trees with a dbh greater than or equal to 18 inches. 3) Calpine will skirt stands of forest, such as red fir, to the greatest extent possible.	USFS	1) Field inspect and review the location of wellfield facilities and the routing of routing of the transmission line and temporary freshwater pipeline in order to ensure that vegetation loss is minimized. 2) Record areas of late seral stage forest and trees with a dbh greater than or equal to 18 inches, and document the amount that is avoided and the amount that would be affected.	1) Prior to construction activities.
4.8.1d For stands of late seral stage forest that are lost due to project construction, compensation shall be provided by Calpine in accordance with the standards and guidelines of the Northwest Forest Plan (USFS and BLM 1994a). Compensation could include activities such as silvicultural enhancement in the form of thinning understory or prescribing underburning techniques of an acreage equivalent to that removed by project activities. The USFS shall identify appropriate sites for compensation through a collection agreement with Calpine prior to the commencement of construction activities. (C)	1) Calpine and the USFS will determine the loss of late seral stage forest. 2) Calpine will coordinate with the USFS to determine the amount and appropriate type of compensation required, to identify appropriate sites for compensation, and will provide compensation.	USFS	1) Conduct field review to identify and record areas of late seral stage forest and trees. 2) Upon determination of the amount and appropriate type of compensation required, document this information. 3) Field inspect compensation to ensure that compensation is provided, and record results of field inspection.	1) Identify and document affected areas of late seral stage forest prior to commencement of construction activities. 2) Field inspect compensation upon completion of the provision of compensation.
4.8.1e For trees and snags with dbh greater than or equal to 18 inches that are removed during construction of the transmission line, compensation shall be provided by Calpine in accordance with the standards and guidelines of the Northwest Forest Plan (USFS and BLM 1994a). Per these guidelines, all loss of snags with dbh of 18 inches or more shall be mitigated for at an off-site location that is a distance of 250 feet or more from any edge of an area cleared for project	1) Calpine and the USFS will determine the loss of trees and snags with a dbh greater than or equal to 18 inches. 2) Calpine will coordinate with the USFS to determine the amount and appropriate type of compensation required, to identify appropriate sites for compensation, and will provide compensation. 3) Calpine will hire a qualified	USFS	1) Conduct field review to identify and record trees and snags with a dbh greater than or equal to 18 inches that would be affected. 2) Upon determination of the amount and appropriate type of compensation required, document this information. 3) Review report by qualified biologist documenting the presence or absence of special-status species	1) Identify and document affected trees and snags with a dbh greater than or equal to 18 inches prior to commencement of construction activities. 2) Field inspect compensation upon completion of the provision of compensation.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
facilities. The trees selected for snag creation shall be inspected by a qualified wildlife biologist to ensure that they are not occupied by bats or other special-status wildlife. Snag creation (or other compensatory measures) could include the killing of live trees, or the acceleration of the development of stands to increase tree senescence. (C)	biologist to inspect the trees selected for snag creation to ensure that they are not occupied by bats or other special-status wildlife.		in the trees selected for snag creation. 4) Field inspect compensation to ensure that compensation is provided, and record results of field inspection.	
4.8.2a Use standard noise controls and reduction measures on construction, well drilling, and power plant equipment to minimize disturbance of general wildlife in the area. (C, O, D)	1) Calpine will use standard noise controls and reduction measures on construction, well drilling, and power plant equipment. 2) Calpine will include this measure in construction specifications.	USFS	1) Review equipment specifications to ensure this measure is incorporated. 2) Periodically inspect project to ensure noise controls and reduction measures are implemented.	1) Review equipment specifications prior to commencement of construction. 2) Periodically inspect project throughout construction, operation, and decommissioning to ensure noise controls and reduction measures are implemented.
4.8.3a Preconstruction surveys for certain special-status species shall be conducted prior to the commencement of construction activities to identify the actual presence of these species in potential habitat, and to identify specific areas to be avoided during project construction. Surveys shall be administered by a qualified biologist and will follow USFS protocol or other survey methodology as directed by the USFS. Surveys shall be completed for the species listed in mitigation measures 4.8.3b through 4.8.3l, and 4.8.3p through 4.8.3r, which include the Cooper's hawk, northern goshawk, northern spotted owl, sage grouse, Swainson's hawk, pallid bat, Townsend's big-eared bat, *Myotis sp.* and silver-haired bats, American marten, and survey and manage mollusks. (C)	1) Calpine will contract with a qualified biologist(s) to conduct preconstruction surveys for special-status species following USFS protocol or other survey methodology as directed by the USFS, and will enact mitigation measures 4.8.3b through 4.8.3l, and 4.8.3p through 4.8.3r as necessary to avoid effects to special-status species.	USFS	1) Review and approve qualified biologist(s) selected by Calpine to conduct preconstruction surveys. 2) Conduct field review with Calpine and the qualified biologist(s) to identify actual presence of special-status species in potential habitat, and to identify specific areas to be avoided during project construction. 3) Determine the need for and extent of implementation of mitigation measures 4.8.3b through 4.8.3l, and 4.8.3p through 4.8.3r to avoid effects to special-status species. 4) Field inspect construction to ensure that mitigation measures are implemented, and that effects to special-status species are avoided.	1) Review and approve qualified biologist(s) and conduct field review with Calpine and the qualified biologist(s) prior to construction. 2) Determine the need for and extent of implementation of mitigation measures to avoid effects to special-status species prior to commencement of construction. 3) Field inspect during construction to ensure that mitigation measures are implemented, and that effects to special-status species are avoided.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.8.3b **Cooper's hawk:** During the spring of the year prior to construction and decommissioning of the transmission line, survey for active Cooper's hawk nests in a corridor extending 0.25 mile from the centerline of transmission line in potential Cooper's hawk habitat. Avoid disturbance to any active Cooper's hawk nest sites within this corridor by maintaining a limited operating period (March 1 to August 31). During this period, construction and decommissioning activities shall be prohibited within 0.25 mile of the nest site. All other forested habitats that may provide nest sites for Cooper's hawks along the transmission route proposed for this alternative have been surveyed for raptor nests and no active nests have been found in areas that would be disturbed by project construction activities. However, preconstruction surveys shall also be conducted in these areas to ensure nesting has not occurred since the last surveys were conducted. (C, D)	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for active Cooper's hawk nests, and will avoid disturbance to any active nest sites through limited construction operating periods.	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Conduct field review with Calpine and the qualified biologist to identify active Cooper's hawk nests. 3) Record active Cooper's hawk nests that shall be avoided by Calpine. 4) Field inspect construction and decommissioning to ensure conformance with the limited construction operating period in the vicinity of active Cooper's hawk nests.	1) Review and approve the qualified biologist and conduct field review with Calpine and the qualified biologist prior to construction. 2) Record active Cooper's hawk nests to be avoided prior to commencement of construction. 3) Field inspect during construction and decommissioning to ensure conformance with the required limited construction operating periods.
4.8.3c **Northern goshawk:** A limited construction and operating period shall be in effect to protect the goshawk nest site in the west-central portion of the wellfield and power plant area. This limitation will prohibit certain activities (depending on distance from the stand) between March 1 and August 31 of each calendar year. This limitation includes no noise disturbance or habitat modifying activities within 0.25 mile of the nest site during this period (this includes limiting truck traffic on Forest Road 44N54 between March 1 and August 31 by designating an alternate route away from the goshawk stand). This limitation also includes no habitat-modifying activities within 0.25 to 0.5 mile of the goshawk nest site during this period, but allows noise disturbance within this	1) Calpine will perform construction activities in the wellfield and power plant area in accordance with the limited construction and operating period for northern goshawk. 2) Calpine will limit truck traffic on Forest Road 44N54 in accordance with the limited operating period for northern goshawk. 3) Calpine will instruct personnel on the importance of isolating the goshawk stand from noise and unnecessary human disturbance.	USFS	1) Field inspect construction of well pads P-4, P-5, I-2, and I-3 to ensure that these pads and associated pipelines and roads are not constructed between March 1 and August 31. 2) Verify that Calpine personnel are aware of the restrictions on activities near the goshawk stand.	1) Conduct field inspections periodically during construction, operation, and decommissioning.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
distance. Therefore, the following activities would be prohibited during this period within 0.25 and 0.5 mile of the goshawk nest site: (1) Construction of well pads P-4, P-5, I-2, and I-3 (2) road construction, and (3) well drilling. The testing and operation of wells at these pads would not be restricted within 0.25 and 0.5 mile of the goshawk nest site. Beyond 0.5 mile from the goshawk nest site, no restrictions on operation and construction activities will apply. In addition, all Calpine employees and contract personnel working at the site will be notified of the importance of isolating the goshawk nest site from noise and unnecessary human activity. Personnel will be prohibited from conducting field activities within 0.25 mile of the goshawk nest site unless authorized by the USFS. (C, O, D)				
4.8.3d **Northern goshawk:** Preconstruction surveys shall be conducted upon identification and selection of the transmission line alignment to identify goshawk nest sites along this route and to identify specific areas where limited project-related activities would be allowed to occur. (C, D)	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for northern goshawk nests, and will avoid disturbance to any active nest sites through limited construction and operating periods.	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Conduct field review with Calpine and the qualified biologist to identify northern goshawk nests. 3) Record northern goshawk nests that shall be avoided by Calpine. 4) Field inspect construction and decommissioning to ensure conformance with the limited construction and operating period in the vicinity of northern goshawk nests.	1) Review and approve the qualified biologist and conduct field review with Calpine and the qualified biologist prior to construction. 2) Record northern goshawk nests to be avoided prior to commencement of construction. 3) Field inspect during construction and decommissioning to ensure conformance with the required limited construction and operating periods.
4.8.3e **Northern Spotted Owl:** Conduct appropriate surveys for northern spotted owl roosting or nesting habitat prior to construction of the transmission line and installation of the temporary freshwater pipeline in a corridor extending 0.25 mile	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys to identify northern spotted owl roosting and nesting habitat, and will avoid disturbance to habitat through	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Conduct field review with Calpine and the qualified biologist	1) Review and approve the qualified biologist and conduct field review with Calpine and the qualified biologist prior to construction. 2) Record northern spotted owl

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
from the centerline of transmission line segments in the Medicine Lake Highlands, and along the freshwater pipeline route. If there is suitable northern spotted owl roosting or nesting habitat within 0.25 mile of the freshwater pipeline and transmission line right-of-way, then no construction activity shall occur in these areas between February 1 and July 31. During annual spring maintenance, transmission line helicopter maintenance within 0.25 mile of suitable roosting or nesting habitat shall not be used. Instead, snowmobiles or sno-cats may be used to access these portions of the transmission line for annual spring maintenance. (C, O, D)	limited construction periods. 2) Calpine will use means other than helicopters to conduct annual spring maintenance of the transmission line in the vicinity of northern spotted owl habitat.		to identify northern spotted owl roosting and nesting habitat. 3) Record northern spotted owl roosting and nesting habitat that shall be avoided by Calpine. 4) Field inspect construction and decommissioning to ensure conformance with the limited construction period in the vicinity of northern spotted owl habitat. 5) Field inspect annual spring maintenance to ensure that means other than helicopters are used.	habitat to be avoided prior to commencement of construction. 3) Field inspect during construction and decommissioning to ensure conformance with the required limited construction periods. 4) Field inspect annual spring maintenance during operation.
4.8.3f **Sage grouse:** During the spring of the year prior to construction and decommissioning of the transmission line, survey the project site to determine whether or not active sage grouse strutting grounds are present. No transmission line or access road shall be constructed within 0.5 mile of a known strutting ground (as identified in CNDDB or USFS records or through preconstruction surveys). No project activities likely to create noise or disturbance shall be conducted within 0.5 mile of a known strutting ground during the spring breeding season (February 15 through April 30). (C, D)	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys to identify active sage grouse strutting grounds. 2) Calpine will not construct the transmission line or access roads within 0.5 mile of known strutting ground, and will avoid disturbance to strutting ground through limited construction periods.	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Conduct field review with Calpine and the qualified biologist to identify active sage grouse strutting grounds. 3) Record active sage grouse strutting grounds that shall be avoided by Calpine. 4) Field inspect construction and decommissioning to ensure avoidance of known strutting grounds and conformance with the limited construction period in the vicinity of strutting grounds.	1) Review and approve the qualified biologist and conduct field review with Calpine and the qualified biologist prior to construction. 2) Record active sage grouse strutting grounds to be avoided prior to commencement of construction. 3) Field inspect during construction and decommissioning to ensure conformance with the required limited construction periods.
4.8.3g **Swainson's hawk:** During the spring of the year prior to construction and decommissioning of the transmission line, survey juniper woodland habitat for active Swainson's hawk nests in a corridor extending 0.25 mile from the centerline. Avoid disturbance to any active	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for active Swainson's hawk nests, and will avoid disturbance to any active nest sites through limited construction operating periods.	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Conduct field review with Calpine and the qualified biologist to identify active Swainson's hawk	1) Review and approve the qualified biologist and conduct field review with Calpine and the qualified biologist prior to construction. 2) Record active Swainson's hawk nests to be avoided prior to

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
Swainson's hawk nest sites within this corridor by maintaining a limited operating period (March 1 to July 31). During this period, construction and decommissioning activities shall be prohibited within 0.25 mile of the nest site. (C, D)			nests. 3) Record active Swainson's hawk nests that shall be avoided by Calpine. 4) Field inspect construction and decommissioning to ensure conformance with the limited operating period in the vicinity of active Swainson's hawk nests.	commencement of construction. 3) Field inspect during construction and decommissioning to ensure conformance with the required limited operating periods.
4.8.3h **Pallid bat:** Prior to construction and decommissioning of project facilities in pallid bat habitat, survey for potential diurnal roosting habitat. Also survey for potential roosting habitat within a 250-foot buffer area on either side of the transmission line corridor and along proposed access roads. Avoid removal of snags and defective trees with dbh of 18 inches or more to the greatest extent possible during construction of project facilities. All loss of snags with dbh of 18 inches or more shall be mitigated for at an off-site location at a distance of 250 feet or more from the edge of areas cleared for project facilities. (C, D)	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for potential diurnal roosting habitat. 2) Calpine will avoid removal of snags and defective trees with dbh of 18 inches or more, and will compensate for loss of snags with dbh of 18 inches or more.	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Conduct field review with Calpine and the qualified biologist to identify potential diurnal roosting habitat. 3) Record potential diurnal roosting habitat that shall be avoided by Calpine, and habitat that can not be avoided. 4) Identify appropriate compensation for loss of snags with dbh of 18 inches or more to avoid effects to pallid bat. 5) Field inspect construction and decommissioning to verify that habitat that can be avoided is actually being avoided. 6) Field inspect compensation to ensure that compensation is provided, and record results of field inspection.	1) Review and approve the qualified biologist and conduct field review with Calpine and the qualified biologist prior to construction. 2) Record potential diurnal roosting habitat to be avoided and habitat that can not be avoided prior to commencement of construction. 3) Identify appropriate compensation prior to construction. 4) Field inspect during construction and decommissioning to verify habitat avoidance and implementation of compensation.
4.8.3i **Townsend's big-eared bat:** Prior to construction and decommissioning of project facilities, survey for potential diurnal roosting habitat in the form of caves in all areas that shall be cleared or disturbed, and in a 250-foot buffer area on	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for potential diurnal roosting habitat in the form of caves, and will not construct project facilities within	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Conduct field review with	1) Review and approve the qualified biologist and conduct field review with Calpine and the qualified biologist prior to construction.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
either side of these project facilities. When constructing project facilities, avoid impacts to caves that provide roosting habitat by enforcing a 250-foot buffer zone around these habitat features. (C, D)	250 feet of caves that could provide potential diurnal roosting habitat.		Calpine and the qualified biologist to identify potential diurnal roosting habitat. 3) Record potential diurnal roosting habitat that shall be avoided by Calpine. 4) Field inspect construction and decommissioning to verify that project facilities are not being constructed with 250 feet of caves that could provide potential diurnal roosting habitat.	2) Record potential diurnal roosting habitat to be avoided prior to commencement of construction. 3) Field inspect during construction and decommissioning to verify habitat avoidance.
4.8.3j ***Myotis sp.* and silver-haired bat species:** Prior to construction and decommissioning of project facilities, survey for potential diurnal roosting habitat in all areas that shall be cleared or disturbed and in a 250-foot buffer area on either side of these project facilities. If possible, avoid high quality roosting habitat in the form of snags and defective trees with dbh of 18 inches or more during construction of project facilities. All loss of snags with dbh of 18 inches or more shall be mitigated for off-site at a distance of 250 feet or more from the edge of areas cleared for project facilities. (C, D)	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for potential diurnal roosting habitat. 2) Calpine will avoid removal of snags and defective trees with dbh of 18 inches or more, and will compensate for loss of snags with dbh of 18 inches or more.	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Conduct field review with Calpine and the qualified biologist to identify potential diurnal roosting habitat. 3) Record potential diurnal roosting habitat that shall be avoided by Calpine, and habitat that can not be avoided. 4) Identify appropriate compensation for loss of snags with dbh of 18 inches or more to avoid effects to *Myotis sp.* and silver-haired bat species. 5) Field inspect construction and decommissioning to verify that habitat that can be avoided is actually being avoided. 6) Field inspect compensation to ensure that compensation is provided, and record results of field inspection.	1) Review and approve the qualified biologist and conduct field review with Calpine and the qualified biologist prior to construction. 2) Record potential diurnal roosting habitat to be avoided and habitat that can not be avoided prior to commencement of construction. 3) Identify appropriate compensation prior to construction. 4) Field inspect during construction and decommissioning to verify habitat avoidance and implementation of compensation.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.8.3k **American marten:** In order to minimize the potential impact to American marten using den sites within the wellfield and power plant area, all proposed facility locations shall be surveyed using the Regional Furbearer technique by a qualified biologist for log piles, hollow logs, and other suitable denning structures once during the summer and once during the winter prior to construction. Any potentially suitable marten denning structures shall be disassembled or removed slowly and watched carefully by a qualified biologist for the presence of marten. If marten are detected, activity shall cease to allow the animal to escape safely. The log piles, hollow logs, or other structures shall be reassembled at the periphery of the facility location to allow for use as potential dens. Within the wellfield and power plant area, pile and retain trees (per direction of the USFS) that are removed during construction at the periphery of the facility location to allow for use as a potential den. (C)	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for suitable denning structures within the wellfield and power plant area, and to monitor removal and reassembly of these structures. 2) Calpine will pile and retain trees at the direction of the USFS to provide suitable denning structures.	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Conduct field review with Calpine and the qualified biologist to identify suitable denning structures. 3) Monitor removal and reassembly of suitable denning structures.	1) Review and approve the qualified biologist and conduct field review with Calpine and the qualified biologist prior to construction. 2) Monitor removal and reassembly of suitable denning structures during construction.
4.8.3l **American marten:** Along the transmission route, pile and retain trees that are removed during clearance of the 125-foot-wide corridor within marten habitat (above 5,000 feet) to allow for use as potential den structures. Provide at least four log piles (sized as directed by the USFS) along the periphery of the cleared corridor on every mile of the route through marten habitat. (C)	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys to verify suitable habitat along the transmission line route and to monitor assembly of suitable denning structures. 2) Calpine will pile and retain trees at the direction of the USFS to provide suitable denning structures in affected habitat along the transmission line route.	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Conduct field review with Calpine and the qualified biologist to verify suitable habitat. 3) Monitor assembly of suitable denning structures.	1) Review and approve the qualified biologist and conduct field review with Calpine and the qualified biologist prior to construction. 3) Monitor assembly of suitable denning structures during construction.
4.8.3m **Mule deer:** No construction or decommissioning activities shall be allowed from December 1 through March 31 (adjusted by the USFS as necessary to ensure the intent of the seasonal	1) Calpine will not conduct construction or decommissioning activities between December 1 and March 31 (or as adjusted by the USFS) in mule deer winter range.	USFS	1) Ensure that Calpine is aware of mule deer winter range. 2) Field inspect project construction and decommissioning in mule deer	1) Ensure awareness of mule deer winter range prior to construction and decommissioning. 2) Field inspect during project

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
restriction) in mule deer winter range. Wildlife "guzzlers" shall be placed in mule deer summer range to enhance habitat.(C, D)	2) Calpine will place wildlife guzzlers in mule deer summer range to enhance habitat.		winter range to ensure that no construction or decommissioning activities occur between December 1 and March 31 (or as adjusted by the USFS). 3) Direct the appropriate placement of wildlife guzzlers in mule deer summer range, and field inspect to verify placement.	construction and decommissioning, between December 1 and March 31 (or as adjusted by the USFS). 3) Ensure the placement of wildlife guzzlers during construction.
4.8.3n **Pronghorn:** When constructing the transmission line through pronghorn habitat, avoid or minimize surface disturbance in known kidding grounds (as defined in CNDDB and/or USFS records). During the period between May 1 to June 31 (adjusted by the USFS as necessary to ensure the intent of the seasonal restriction), construction and decommissioning activities shall be prohibited within 0.25 mile of the kidding ground. (C, D)	1) Calpine will avoid and minimize surface disturbance in known pronghorn kidding grounds, and will not conduct construction and decommissioning activities within 0.25 mile of known kidding grounds between May 1 and June 31 (or as adjusted by the USFS).	USFS	1) Ensure that Calpine is aware of known pronghorn kidding grounds, and that construction and decommissioning will avoid or minimize surface disturbance in these areas. 2) Field inspect construction and decommissioning in known pronghorn kidding grounds to ensure that surface disturbance is avoided and minimized. 3) Field inspect construction and decommissioning to ensure that no construction or decommissioning activities occur within 0.25 mile of known kidding grounds between May 1 and June 31 (or as adjusted by the USFS).	1) Ensure awareness of known pronghorn kidding grounds and that construction and decommissioning will avoid or minimize surface disturbance in these areas prior to construction and decommissioning. 2) Field inspect during project construction and decommissioning to ensure that surface disturbance is avoided and minimized in kidding grounds. 3) Field inspect during project construction and decommissioning, between May 1 and June 31 (or as adjusted by the USFS), to ensure no construction or decommissioning activities occur within 0.25 mile of known kidding grounds.
4.8.3o In order to eliminate the chance of wildlife coming in contact with geothermal fluids that are temporarily and infrequently present in the sumps, netting or other protective measures (as agreed to by the USFWS) will be placed over each sump and fencing will be placed around the perimeter of the sumps. If netting is used, the netting material and mesh size will be sufficient to prevent birds or bats from contacting the contents of the sump but not to trap birds or bats in the netting itself. (C, O)	1) Calpine will install netting or other material over each sump to prevent wildlife from coming into contact with fluids in the sump.	USFS	1) Assist Calpine in choosing the material that will cover the sump. 2) Inspect the sump in the field after the material is installed. 3) Periodically monitor the sumps to ensure that wildlife is not coming into contract with fluids, or being trapped by the material.	1) Assist Calpine in choosing the material prior to construction. 2) Conduct inspections after construction.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.8.3p **Oregon shoulderband:** Prior to construction and decommissioning of project facilities, survey potential habitat according to the survey protocol for terrestrial mollusks in the Northwest Forest Plan. When constructing project facilities and when possible, avoid impacts to important habitat features such as areas of extensive leaf litter and large woody debris. (C, D)	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for the Oregon shoulderband and its suitable habitat. 2) During construction, Calpine shall minimize disturbance to habitat for special-status mollusks.	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Review the report prepared by the biologist on the Oregon shoulderband in the project area. 3) Assist Calpine in minimizing disturbance to the habitat of this species.	1) review and approve the qualified biologist and conduct field review with Calpine and the qualified biologist prior to construction. 2) Assist Calpine in minimizing disturbance to mollusk habitat prior to construction.
4.8.3q **Papillose tail-dropper:** Prior to construction and decommissioning of project facilities, survey potential habitat according to the survey protocol for terrestrial mollusks in the northwest Forest Plan. When constructing project facilities and when possible, avoid impacts to important habitat features such as areas of extensive leaf litter and large woody debris. (C, D)	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for the Papillose taildropper and its suitable habitat. 2) During construction, Calpine shall minimize disturbance to habitat for special-status mollusks.	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Review the report prepared by the biologist on the Papillose taildropper in the project area. 3) Assist Calpine in minimizing disturbance to the habitat of this species.	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for the Papillose taildropper and its suitable habitat. 2) During construction, Calpine shall minimize disturbance to habitat for special-status mollusks.
4.8.3r **Klamath sideband:** Prior to construction and decommissioning of project facilities, survey potential habitat according to the survey protocol for terrestrial mollusks in the Northwest Forest Plan. When constructing project facilities and when possible, avoid impacts to important habitat features such as rock outcroppings, lava rockslides, and large woody debris. (C, D)	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for the Klamath sideband and its suitable habitat. 2) During construction, Calpine shall minimize disturbance to habitat for special-status mollusks.	USFS	1) Review and approve the qualified biologist selected by Calpine to conduct preconstruction surveys. 2) Review the report prepared by the biologist on the Papillose taildropper in the project area. 3) Assist Calpine in minimizing disturbance to the habitat of this species.	1) Calpine will contract with a qualified biologist to conduct preconstruction surveys for the Klamath sideband and its suitable habitat. 2) During construction, Calpine shall minimize disturbance to habitat for special-status mollusks.
4.8.4a Overhead ground wires and conductors should be placed at or below the surrounding forest canopy wherever possible.. As directed by the USFS, marking devices will be installed along segment C1 or C2 (where greater sandhill cranes may be active). Marking devices could include aerial marker spheres, spiral	1) Calpine will place overhead ground wires and conductors at or below the surrounding forest canopy where possible. 2) Install marking devices along segment C1 or C2 where sandhill cranes may be active.	USFS	1) Review design plans to ensure that overhead ground wires and conductors will be at or below the surrounding forest canopy where possible. 2) Identify the appropriate type of marking system to be installed	1) Review design plans and identify the locations and appropriate type of marking system to be installed prior to construction. 2) Field inspect portions of the transmission line requiring a marking system during

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
vibration dampers, or bird flight-diverters. (C)	3) Calpine will include this measure in final design plans.		along segment C1 or C2. 3) Field inspect construction of these portions of the transmission line to ensure that the appropriate type of marking system is installed.	construction to ensure that the appropriate type of marking system is installed.
VISUAL QUALITY				
4.9.2a Well venting shall be conducted to minimize the size and visibility of steam plumes, and will include directing geothermal fluids from the wellhead to a portable silencer, allowing for minimization of particulate matter. (C, O)	1) Calpine will conduct well venting to minimize the size and visibility of steam plumes, and will direct geothermal fluids from the wellhead to a portable silencer.	USFS	1) Monitor site to ensure well venting is conducted to minimize the size and visibility of steam plumes.	1) Monitor site periodically to ensure well venting is conducted to minimize the size and visibility of steam plumes.
4.9.2b Although not required to reduce a significant impact, cooling towers shall be designed to minimize the size of the steam plume. Calpine shall review plume reduction technology during design to determine if feasible technology exists. The available technology shall be reviewed with the BLM and the USFS. If feasible technology is available, it shall be used in cooling tower construction. (O)	1) Calpine will incorporate this measure into the final design and construction specifications for the power plant. 2) Calpine will review available technology at the time of final plant design and discuss feasibility with the USFS and BLM. Calpine will then implement any feasible plume reduction technology.	USFS and BLM	1) Review final design and construction specifications for the wellfield and power plant to review feasible technology.	1) Review final design and construction specifications for the wellfield and power plant to ensure measure is implemented.
4.9.2c Prepare and submit to the Klamath National Forest for approval, a detailed Exterior Lighting Design and Management Plan that incorporates the following guidelines: • Use lights that may be within view of Primary Forest Route 49 and other identified sensitive viewpoints only when necessary, such as for emergency purposes or when conducting routine night-time maintenance activities. • Exterior facility lighting should be limited to necessary facilities that are essential for operations. • Constant area lighting would be limited only to those places that must be	1) Calpine will prepare and submit to the Klamath National Forest for approval, a detailed Exterior Lighting Design and Management Plan, to incorporate the guidelines identified in measure 4.9.2c. 2) Visibility tests will be conducted during summer and winter months. 3) The USFS will field verify the analysis presented in the Draft EIS/EIR. 4) Once approved, Calpine will incorporate the lighting designs and plans into the final design and construction specifications for the	USFS	1) Review and approve the Exterior Lighting Design and Management Plan. 2) Review final design and construction specifications for the wellfield and power plant to ensure plan is incorporated. 3) Monitor site to ensure that the plan is being implemented.	1) Review and approve the plan prior to development of the final design and construction specifications. 2) Review final design and construction specifications to ensure plan is incorporated, prior to the initiation of construction activities. 3) Monitor site once during construction and at the completion of construction to ensure measures are being implemented.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
observed from a distance for safety purposes. • Area lighting, cooling tower exterior lighting, and security lighting should be controlled by the use of timed switches and/or motion detector activation control so lights are only on when necessary. • All light fixtures should include shrouds (either fixed or adjustable), other shielding, or be directed in such a way as to block direct light from Forest Road 49, from identified sites located in the west portion of the Medicine Lake Highlands that are significant to traditional cultural values, and from other identified sensitive viewpoints. • Drill rig mast lighting shall also be shrouded and directed down the drill mast, not out from it. (This mitigation does not apply to any lighting of the mast to meet FAA requirements). • Stray light should be controlled through use of low-brightness fixtures with optical controls. (C, O)	wellfield and power plant area.			
4.9.2d Standard site planning and construction methods would be followed to minimize the visual disturbance to the existing landscape caused by construction. These include methods such as: • Limiting construction access to identified routes • Designating layout space and other construction zones to pre-defined areas • Identifying and clearly delineating grading and construction limit lines around the power plant site, all well pads, and along the pipeline routes	1) Calpine will incorporate the site planning and construction methods into the final design and construction specifications for the wellfield and power plant area.	USFS	1) Review final design and construction specifications for the wellfield and power plant to ensure measures are incorporated. 2) Periodically monitor site to ensure measures are being implemented.	1) Review final design and construction specifications to ensure measures are incorporated, prior to the initiation of construction activities. 2) Monitor site bi-monthly during construction and at the completion of construction to ensure measures are implemented.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
• Clearing of trees should be limited to the minimum area required • Clearing of land for facilities and structures should use curvilinear boundaries where practical instead of straight lines • Providing dust control measures • Removing construction equipment from the project area when no longer needed • Restoring and revegetating temporary construction areas and equipment storage areas that are no longer needed, in accordance with U.S. Forest Service requirements (C)				
4.9.2e **Landscape Design:** Landscaping should be used in areas visible from Primary Forest Route 49 (the entrance road to the plant site) and Forest Road 44N54 to screen the appearance of project facilities and attain a natural landscape character within a 3-year period to include: • Shaping cuts and fills to appear as natural forms, to the extent possible • Stockpiling and reusing topsoil • Furrowing slopes • Hydroseeding and mulching clear-cut and fill areas • Revegetating cut/fill slopes with native shrub and tree species of sufficient size, growth rate, and density • Fertilizing, mulching, and watering planted areas • Cutting rock areas so that forms are irregular (C, O)	1) Calpine will incorporate the landscape design measures into the final design and construction specifications for the wellfield and power plant area.	USFS	1) Review final design and construction specifications for the wellfield and power plant to ensure measures are incorporated. 2) Periodically monitor site to ensure measures are being implemented.	1) Review final design and construction specifications to ensure measures are incorporated, prior to the initiation of construction activities. 2) Monitor site bi-monthly during construction and once a year for the first three years of operation to ensure measures are being implemented.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.9.2f **Facility Design**: Appropriate facility design standards and facility materials should be used to reduce the visual contrast between project facilities and the characteristic landscape including, but not be limited to: • Using paint or integrated material coloring that is uniform, non-contrasting and non-reflective, except where safety colors are required by code • Selecting facility colors, including any exposed concrete, to blend with the immediate natural environment and to be a shade darker than the adjacent forest landscape to compensate for effects of shade and shadow • Inspecting and repairing facilities annually to evaluate the buildup of dust or other materials and the effects of weathering processes that will reduce the effect of the original colors • Using wooden posts for required signs, and communications antennae • Designing a coordinated signing program which minimizes use of signs and is based on approved USFS sign colors • Using only non-reflective fencing throughout the project (C, O)	1) Calpine will incorporate the facility design measures into the final design and construction specifications for the wellfield and power plant area.	USFS	1) Review final design and construction specifications for the wellfield and power plant to ensure measures are incorporated. 2) Periodically monitor site to ensure measures are being implemented.	1) Review final design and construction specifications to ensure measures are incorporated, prior to the initiation of construction activities. 2) Monitor site once during construction and at the completion of construction to ensure measures are being implemented.
4.9.4a For the entire transmission line route, implement the following measures to minimize the visual effects of right-of-way vegetation clearance and transmission line facilities: • To minimize the need for excessive vegetation clearing from the transmission line right-of-way, prepare a detailed transmission line clearing plan	1) Calpine will prepare a detailed transmission line clearing plan for review and approval by the USFS. 2) Once approved, Calpine will incorporate the measures contained in the clearing plan and the other measures listed in this mitigation into the final design and construction specifications for the	USFS	1) Review and approve the vegetation clearing plan. 2) Review final design and construction specifications for the transmission line to ensure measures are incorporated. 3) Periodically monitor site to ensure measures are being	1) Review and approve the plan prior to development of the final design and construction specifications. 2) Review final design and construction specifications to ensure measures are incorporated, prior to the initiation of construction activities.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
for review and approval by the USFS that takes into account basic principles of feathering and scalloping of the transmission line right-of-way • Prior to clearing activities, identify those trees to be removed, trees to be pruned, and trees to remain within the transmission line right-of-way, with review and approval by the USFS • To reduce reflection and glare, use only non-specular conductors as is already planned for by Calpine • To reduce reflection and glare of metal poles, use flat paint except where safety colors are required by code (C)	transmission line.		implemented.	3) Monitor site bi-monthly during construction to ensure measures are being implemented.
4.9.4b The following measures shall be implemented at road crossings in order to minimize the establishment of a visual corridor from vegetation clearing under the conductor, minimize views down the transmission line right-of-way, and reduce the dominance of the transmission line: • For each transmission pole immediately adjacent to the road, use self-supporting single steel poles rather than H-frame poles. • Site transmission line poles as far away as practical from either side of the road; redirect the transmission line right-of-way from the two poles adjacent to the road at a sufficient angle so that only that portion of the right-of-way between the two poles nearest the road may be visible from the road. • Retain all trees within the right-of-way between 5 feet and 12 feet in height depending on the height of the conductors in that segment (30 or 37 feet clearance between the conductor and the	1) Calpine will incorporate the measures into the final design and construction specifications for the transmission line.	USFS	1) Review final design and construction specifications for the transmission line to ensure measures are incorporated. 2) Periodically monitor site to ensure measures are being implemented.	1) Review final design and construction specifications to ensure measures are incorporated, prior to the initiation of construction activities. 2) Monitor site bi-monthly during construction and once a year for the first three years of operation to ensure measures are being implemented.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
ground) • Regrade to create designed earth berms and/or plant native trees and understory vegetation within 100 feet on either side of the roadway at a density, size, and growth rate sufficient to screen views into the right-of-way from the roadway within a 3-year period. (C, O)				
4.9.4c Reroute the transmission line and utility corridor along segment A1 slightly west of the proposed alignment to avoid crossing Primary Forest Route 77 in a VQO Retention Area. This shall be accomplished by rerouting segment A1 at approximately 0.25 mile from the power plant, due south for approximately 0.75 mile. At approximately 1.0 mile from the power plant, the line shall be redirected back towards the southeast for approximately 1.25 miles to just north of Medicine Lake. From this point just north of Medicine Lake the segment shall continue to follow the proposed alignment of segment A1. Rerouting the transmission line and utility corridor in accordance with this measure shall result in the crossing of Primary Forest Route 77 in a VQO of Partial Retention. (C) *Does not apply to Alternatives 5 and 6.*	1) Calpine will incorporate the measure into the final design and construction specifications for the transmission line.	USFS	1) Review final design and construction specifications for the transmission line to ensure measure is incorporated.	1) Review final design and construction specifications to ensure measure is incorporated, prior to the initiation of construction activities.
4.9.5a Shorten distance between transmission line poles on segment A1 (between mileposts 0.6 and 3.3), to allow for shorter poles while still maintaining adequate clearance between the ground and the conductors (37 feet in the Medicine Lake area) to allow for snow pack. This may reduce the visibility of poles as seen from the Medicine Lake KOPs 2, 3, and 5 by taking advantage of the forest canopy to partially screen the facilities. However, the visibility of the conductors would not be modified by this measure. (C, O)	1) Calpine will incorporate the measure into the final design and construction specifications for the transmission line.	USFS	1) Review final design and construction specifications for the transmission line to ensure measure is incorporated. 2) Periodically monitor site to ensure measure is being implemented.	1) Review final design and construction specifications to ensure measure is incorporated, prior to the initiation of construction activities. 2) Monitor the site bi-monthly during construction.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
Does not apply to Alternatives 5 and 6.				
4.9.5b The following measures shall be implemented along segment A1 (between mileposts 2.9 and 3.2) to reduce visual dominance and right-of-way corridor effects as seen from the Medicine Lake Lava Flow Trail (KOP 4): • Site transmission line towers approximately 200 feet on either side and perpendicular to trail; redirect transmission line right-of-way from the two towers adjacent to the trail at a sufficient angle so that only that portion of the right-of-way between the two towers nearest the trail may be visible from the trail. • Retain all trees within the right-of-way between 5 feet and 12 feet in height depending on the height of the conductors in that segment (would range between 30 and 37 feet). • Where possible, based on the characteristics of the individual tree species involved, top or prune trees taller than 12 feet rather than remove them. • Annually inspect and remove/top only those trees that are necessary for safety purposes. (C, O) *Does not apply to Alternatives 5 and 6.*	1) Calpine will incorporate the measure into the final design and construction specifications for the transmission line.	USFS	1) Review final design and construction specifications for the transmission line to ensure measure is incorporated.	1) Review final design and construction specifications to ensure measure is incorporated, prior to the initiation of construction activities. 2) Monitor site bi-monthly during construction and then annually during maintenance and tree-trimming activities.
4.9.5c Within the designated Medicine Lake Recreation Area, construction activities will be limited from sunrise to sunset in order to limit the need for lighting during the construction phase of the project. (C, D) *Does not apply to Alternatives 5 and 6.*	1) Calpine will incorporate the measure into the final construction specifications for the transmission line.	USFS	1) Review final construction specifications for the transmission line to ensure measure is incorporated. 2) Periodically monitor site to ensure measure is being implemented.	1) Review final construction specifications prior to the initiation of construction activities. 2) Monitor the site bi-monthly during construction.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
PLANS AND POLICIES				
4.10.1a Amend the Klamath LRMP to revise forest-wide standard 24-25 to state: "Protect traditional Native American cultural and religious uses and practices consistent with PL 95-341, American Indian Religious Freedom Act of 1978. (C)	The USFS shall coordinate with Klamath National Forest District staff to update/amend the LRMP.	USFS	The USFS shall coordinate with Klamath National Forest District staff to ensure that amendment is completed.	Ensure that the LRMP amendment is completed in a timely manner.
LAND USE & RECREATION				
4.11.1a In consultation with the USFS and BLM, Calpine shall develop a public information plan by which the local and general public would be notified of upcoming construction activities and schedules. Calpine shall place appropriate signs in approved locations informing users of the recreation area of the construction activities. (C)	1) Calpine will coordinate with the USFS and BLM to develop a public information plan. This plan shall include procedures for notifying the local and general public of upcoming construction activities and schedules. 2) Calpine will place appropriate signs in approved locations informing users of the recreation area of the construction activities.	USFS	1) Monitor approved locations to verify that public information and notification signs have been posted.	1) Public information areas will be monitored monthly throughout the summer recreation season during the construction phase.
4.11.4a Calpine shall sign the intersection of the access road to the plant site with Forest Road 44N54 and feather this crossing for snowmobiles. (C)	1) Calpine will place signs to alert snowmobilers at the intersection of the access road to the pipeline and Forest Road 44N54 prior to the first snowfall after the beginning of construction. 2) When plowing the access road along the cold pipeline, Calpine will feather the intersection of the access road to the plant with Forest Road 44N54 so that road 44N54 remains passable by snowmobiles. 3) Calpine will include this measure in the construction specifications.	USFS	1) Inspect the intersection for the placement of signs. 2) Monitor the crossing periodically during the snow season to verify that road 44N54 remains passable by snowmobiles.	1) Inspect the intersection for the placement of signs prior to the first snowfall of the season. 2) Monitor the crossing periodically during the snow season (particularly after heavy snow falls) through the life of the project.
4.11.8a Calpine shall install temporary cattle guards leading from the transmission line to US 139 when constructing the transmission line between	1) Prior to construction of the transmission line between Tionesta and the substation, Calpine will install temporary cattle guards leading from the transmission line	USFS	1) Inspect the site to verify that temporary cattle guards have been installed.	2) Inspect the site to verify the installation of cattle guards when construction begins on this portion of the transmission line.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
Tionesta and the proposed substation. (C) *Does not apply to Alternatives 2, 4 and 6.*	corridor to US 139. These cattle guards will remain in place until construction of that portion of the transmission line is complete. 2) Calpine will include this measure in the construction specifications.			
4.11.9a In consultation with the USFS, Calpine shall select and plant appropriate timber species as part of revegetation efforts during decommissioning of the project. Ultimately, this replanting program would serve to replace timber lands removed as a result of project development. (D)	1) The USFS shall direct Calpine on the appropriate plant species to use for revegetation during the decommissioning phase. 2) Calpine will complete the replanting program has directed by the USFS.	USFS	1) Monitor revegetation activities during the decommissioning phase to verify that the appropriate plant species are being used. 2) Monitor revegetated areas to verify that revegetation was successful.	1) Monitor revegetation activities periodically during the decommissioning phase. 2) Monitor revegetated areas for three years after planting to verify that revegetation was successful.
TRANSPORTATION				
4.12.1a Calpine, under the direction of the USFS, shall make improvements to Forest Roads 44N01 and 44N64 to ensure that projected traffic volumes can be safely accommodated on these roads. (C)	1) The USFS will determine the road improvements necessary to ensure that Forest Roads 44N01 and 44N64 can safely accommodate project traffic. 2) Calpine will make the road improvements specified by the USFS.	USFS	1) Inspect Forest Roads 44N01 and 44N64 to verify that improvements have been made.	1) Inspect Forest Roads 44N01 and 44N64 to verify improvements have been made at the beginning of the construction phase.
4.12.2a The USFS shall develop a road maintenance plan for project area roads to ensure that the structural integrity of these roads is not impaired by the proposed project. Calpine shall be responsible for implementing or financing this maintenance plan. (C, O, D)	1) The USFS will develop a road maintenance plan to ensure that the structural integrity of project area roads is not impaired by the proposed project. 2) Calpine will implement or finance implementation of this maintenance plan.	USFS	1) Review plan. 2) Monitor project area roads to verify that the road maintenance plan is implemented.	1) Monitor project area roads periodically during the construction, operation, and decommissioning phases to ensure that the road maintenance plan is implemented.
4.12.3a. The USFS shall require that Calpine develop and implement a construction and decommissioning access plan that stipulates construction and decommissioning equipment and truck access routes into the proposed transmission line route along segments A1	1) Calpine will develop and implement a construction and decommissioning access plan that stipulates construction and decommissioning equipment and truck access routes into the proposed transmission line route	USFS	1) Review plan. 2) Monitor project area roads to verify that project vehicles are complying with road use limitations.	1) Monitor project area roads periodically during the construction and decommissioning phases.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
and A2. This plan shall also be used for any heavy truck hauling required during the operation phase and shall provide for the following: • Avoidance of Primary Forest Route 49 between Primary Route 97 and 77, in the Medicine Lake area • Avoidance of Forest Road 43N48 • Consideration of Forest Road 43N53 as access points into segments A1 and A2 • Identification of an access route for through traffic between the wellfield and power plant area, and the transmission line route to ensure avoidance of roads identified above • Construction and decommissioning equipment and truck traffic originating from Highway 139 east of the Medicine Lake Highlands would follow a path of travel west on Primary Forest Route 97 to its intersection with Forest Road 44N01, then northwest past Cougar Butte to a section of Primary Forest Route 49 (44N75), and then southward to the wellfield and power plant area • If these roads cannot be avoided, then construction and decommissioning vehicle trips on these roads shall be prohibited from traveling on these roads during weekends and holidays, signage shall be provided in the area warning recreationalists of the presence of construction or decommissioning vehicles, and the applicant shall repair pavement that is damaged and destroyed as a result of construction or decommissioning vehicles. (C, O, D) *Does not apply to Alternatives 5 and 6.*	along segments A1 and A2.			

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
AIR QUALITY				
4.13.1a Calpine shall be required to design and implement measures to control the generation of dust during wellfield, power plant, and transmission line construction. The measures shall be applied during the construction season after the ground becomes dry. Such measures shall be reviewed and approved by the SCAPCD and the USFS and could include, but would not be limited to the following measures: • Apply water or dust palliative (i.e. magnesium chloride) to all active construction areas where soil disturbance is occurring; the amount of watering shall depend on the soil moisture content and the weather conditions • For exposed construction soil stockpiles or inactive construction areas where soil disturbance has occurred, vegetate, enclose, water, or treat with dust palliative • Limit construction vehicle speeds to 25 miles per hour or less on all unpaved roads • Cover all construction trucks hauling loose materials that would travel off forest roads (C, D)	1) Calpine will design and implement measures to control the generation of dust during wellfield, power plant, and transmission line construction and decommissioning. 2) Calpine will include the measures in construction specifications.	SCAPCD and USFS	1) Review and approve measures and ensure measures are incorporated into construction specifications. 2) Monitor the implementation of measures.	1) Design, review and approve measures prior to initiation of construction activities. 2) Monitor construction sites on a bi-monthly basis during construction and decommissioning activities.
4.13.2a H_2S emissions during flow testing shall be monitored and the results reported to the APCD on a schedule approved by the APCD. If the monitoring reveals emissions in exceedance of the APCD's emission limitation, the APCD could require additional control measures to ensure compliance with the emission limitation. Additional control measures could include, but would not be limited to, the following:	1) Calpine will monitor H_2S emissions during flow testing and will report the results to the APCD on a schedule approved by the APCD. 2) Calpine will coordinate with the APCD to approve reporting schedule. 3) Calpine will implement additional measures as determined	SCAPCD	1) Approve reporting schedule. 2) Review reports from Calpine and will determine whether additional measures will be required.	1) Determine a reporting schedule prior to the initiation of construction activities. 2) Monitor emissions during flow testing according to schedule. 3) If additional measures are required, implement during initial well drilling and during in-fill drilling.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
• Reduce the number of wells venting simultaneously • Implement additional wellhead abatement measures, such as caustic injection between the flash tank and the portable silencer (C, O)	by APCD if emissions are in exceedance of the APCD's emissions limitations.			
4.13.5a If during initial well drilling H_2S concentrations in the geothermal resource exceed the expected concentration of 8 ppm, H_2S emissions should be re-modeled to determine H_2S concentrations at adjacent receptors and the potential for exceedances of the state 1-hour standard. Additional mitigation measures to control H_2S may be required, such as the use of a surface condenser instead of a direct-contact condenser. (C, O)	1) Calpine will monitor H_2S concentrations in the resource during initial well drilling and submit data to the APCD. 2) If concentrations exceed 8 ppm, Calpine will remodel H_2S concentrations at adjacent receptors, in coordination with the APCD. 3) Calpine will implement additional measures as determined necessary by APCD if concentrations at receptors are in exceedance of the APCD's emission requirements for H_2S.	SCAPCD	1) Review monitoring data and determine need for re-modeling. 2) Review results of re-modeling report and determine need for additional measures.	1) Monitor concentrations of H_2S in the resources during initial well drilling. 2) Submit monitoring data to APCD. 3) Remodel as necessary to determine concentrations at adjacent receptors. 4) Recommend and implement additional mitigation measures prior to the initiation of construction on the interior portions of the power plant.
4.13.5b Log plant operations after start up to document actual frequency and duration of upset conditions. This information would be used in conjunction with monitoring of H_2S concentrations to evaluate the effectiveness of H_2S abatement systems. If significant impacts are measured, additional abatement measures would be required that are acceptable to the agencies. (O)	1) Calpine will log plant operations after start up to document actual frequency and duration of upset conditions and will report the results to the APCD and BLM on a schedule approved by the APCD. 2) Calpine will coordinate with the APCD to approve reporting schedule. 3) Calpine will implement additional measures as determined necessary by the APCD.	SCAPCD and BLM	1) Approve reporting schedule. 2) Review plant operations data from Calpine and will determine whether additional measures will be required.	1) Begin log at the initiation of plant operations. 2) Submit data to APCD and BLM. 3) Recommend and implement additional mitigation measures during the operation of the power plant.
4.13.5c Calpine shall be required to throttle back the wells to 50 percent of full flow after 1 hour of full-flow venting. After 6 hours, Calpine shall further reduce flow (if possible without damaging the well casings and/or killing the wells) to a level	1) Calpine will throttle back the wells to 50 percent of full flow after 1 hour of full-flow venting. 2) Calpine will collect operational information during the initial year of wellfield production and over	SCAPCD	1) Review plant operations data from Calpine and will determine whether emissions requirements for H_2S are exceeded during upset conditions. 2) Determine whether additional	1) Evaluate wellfield operational information after the first year of power plant operations. 2) Recommend and implement additional mitigation measures during the operation of the power

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
that meets SCAPCD emission requirements for H_2S. Calpine shall evaluate the potential to further reduce flow by collecting operational information during the initial year of wellfield production and over the long term. (O)	the long term, and provide to SCAPCD and BLM. 3) Based on this operational information, Calpine will further reduce flow if possible without damaging or killing wells.		measures will be required to meet emission requirements.	plant, if emissions requirements for H_2S are exceeded. Such measures would include additional throttling back requirements and other measures that could result from the implementation of mitigation measures 4.13.5a and 4.13.5b.
4.13.9a Calpine shall use diesel engines that have ignition timing retard to power drill rigs. Ignition timing retard refers to adjusting an engine's timing such that the fuel is injected into the cylinder later in the cycle, while the piston is traveling downward. This reduces NO_x emissions (by 20-30%) because the combustion takes place at a lower temperature, resulting in less conversion of nitrogen and oxygen present in the intake air to react to form nitric oxide (NO). It should be noted that the NO_x emissions modeled reflect control using ignition timing retard. (C, O)	1) To ensure that drill rig diesel engines have ignition timing retard, Calpine will incorporate this requirement into construction specifications.	SCAPCD	1) Review the construction specifications to ensure this measure is incorporated. 2) Monitor well drilling activities to ensure that drill rigs have ignition timing retard.	1) Review construction specifications prior to the initiation of well drilling to ensure this measure is incorporated. 2) Monitor initial well drilling activities during the first three years of well field production and during in-fill well drilling. Monitoring will be conducted bi-monthly during the first three years of production.
NOISE				
4.14.2a Calpine shall use feasible noise controls on standard construction equipment to minimize potential noise effects to existing nearby residences. Impact tools should be shielded or shrouded when practicable, and equipment should have a muffled exhaust. (C, O, D)	1) Calpine will incorporate the use of feasible noise controls on standard construction equipment in the construction specifications.	USFS	1) Review construction specifications for the wellfield and power plant and for the transmission line to ensure measure is incorporated. 2) Monitor site to ensure that the measure is being implemented.	1) Review construction specifications prior to the initiation of construction activities. 2) Monitor site bi-monthly during construction to ensure measures are being implemented
4.14.2b For the portion of segment A1 located within the Modoc National Forest, Calpine shall not perform transmission line construction activities on Sundays and legal holidays or between the hours of 10:00 p.m. and 7:00 a.m. (C) *Does not apply to Alternatives 5 and 6.*	1) Calpine will incorporate this measure in the construction specifications.	USFS	1) Review construction specifications to ensure measure is incorporated. 2) Monitor construction activities to ensure that the measure is being implemented.	1) Review construction specifications prior to the initiation of construction activities. 2) Monitor site bi-monthly during construction to ensure measure is being implemented.
4.14.2c Calpine or its contractors shall implement site-specific measures to respond to complaints and minimize	1) Calpine will incorporate this measure in the construction bid specifications.	USFS	1) Review construction specifications to ensure measure is incorporated.	1) Review construction specifications prior to the initiation of construction activities.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
future disturbances of nearby residences. Such measures could include changing the location of stationary equipment, installing acoustic barriers around stationary construction noise sources, shutting off idling equipment, and rescheduling construction activity. (C)	2) Calpine will respond to noise complaints by implementing site-specific measures to respond to such complaints, as detailed in the measure. 3) Calpine will inform the USFS of any noise complaints received and actions taken to respond to such complaints.		2) Monitor Calpine's response to noise complaints to ensure that they are appropriately responded to and that future disturbances of nearby residences are minimized.	2) Monitor Calpine's response to noise complaints during the construction period.
4.14.3a For the portion of segment C1 located east of the PacifiCorp and USWAPA 500 kV corridor and west of Highway 139, Calpine shall not perform transmission line construction activities on Sundays and legal holidays or between the hours of 10:00 p.m. and 7:00 a.m. (C) *Does not apply to Alternatives 2, 4, and 6.*	1) Calpine will incorporate this measure in the construction specifications.	USFS	1) Review construction specifications to ensure measure is incorporated. 2) Monitor construction activities to ensure that the measure is being implemented.	1) Review construction specifications prior to the initiation of construction activities. 2) Monitor site bi-monthly during construction to ensure measure is incorporated.
HUMAN HEALTH AND SAFETY				
4.15.1a Calpine shall document appropriate material storage and handling procedures and make these procedures available to workers. Calpine shall also train plant personnel in handling hazardous materials, and place appropriate labels and warning signs on containers and post labels and signs in storage and handling areas. (C, O, D)	1) Calpine will document appropriate material storage and handling procedures and make these procedures available to workers. 2) Calpine will train plant personnel in handling hazardous materials. 3) Calpine will place appropriate labels and warning signs on containers and post labels and signs in storage and handling areas.	USFS	1) Verify that documentation of the material storage and handling procedures are made available to workers by meeting with Calpine and workers personally. 2) Attend training sessions to monitor that personnel are trained in handling hazardous materials adequately. 3) Monitor the site to ensure that labels and signs are placed in storage and handing areas.	1) Implement this measure throughout the lifetime of this project.
4.15.1b Calpine shall follow safe housekeeping practices in storage and handling of all hazardous materials on site. Such practices would include but not be limited to storing reagents and other chemicals in appropriate containers within secondary containment structures, storing chemicals in such a manner as to avoid	1) Calpine will implement safe housekeeping practices in storage and handling of all hazardous materials on site, as identified in this measure.	USFS	1) Inspect the project site to ensure that safe housekeeping practices are followed for the storage and handling of all hazardous materials on site.	1) Implement measure during construction, operation, and decommission of the project. 2) Monitor site periodically to ensure safe housekeeping measures are implemented.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
exposure to other potentially reactive chemicals or to ignition sources, keeping storage areas clean and orderly, cleaning spills as soon as practicable, and following appropriate health and safety measures when handling chemicals. (C, O, D)				
4.15.1c Calpine shall submit copies of all hazardous materials safety, control, and emergency response plans to Siskiyou County Environmental Health Services for review and reference. These plans also should be submitted to the USFS, BLM and local fire protection districts for their review and reference in the case of an emergency at the plant site, as these parties would be contacted in such an event. These plans should include information on the potential hazardous materials that could be encountered by emergency response personnel. In addition, the emergency response plan also shall include such items as a list of emergency contact persons, an evacuation plan and notification plan. (C, O, D)	1) Calpine will submit copies of all hazardous materials safety, control, and emergency response plans to Siskiyou County Environmental Health Services for review and reference. 2) Calpine will submit this plan to the USFS, BLM and local fire protection districts for their review and reference. 3) Calpine will review plans to ensure that it includes information on the potential hazardous materials that could be encountered by emergency response personnel; and, a list of emergency contact persons, an evacuation plan and notification plan within the plan itself.	USFS, BLM, local fire districts, Siskiyou County Environmental Health Services	1) The responsible agencies will review the plans to ensure they are adequate and keep them on file.	1) Review plan prior to the beginning of construction activities.
4.15.3a Calpine shall implement the following measures to avoid the effects of potential blowouts in the power plant and wellfield area: • Wells should be sited away from potential landslide areas • Proper mud density should be maintained • Formation pressure should be monitored • The power plant facility should have an emergency program in the control area which would allow the operator to shut-in a single well, or multiple wells simultaneously, in an emergency	1) Calpine will coordinate with the design engineer to ensure wells are sited away from potential landslide areas. 2) Calpine will incorporate an emergency program in the power plant facility, to enable the operator to shut-in a single well, or multiple wells simultaneously, in an emergency situation. 3) Calpine will incorporate these measures into the final design and construction specifications.	BLM and USFS	1) Review final design and construction specifications to ensure measures are incorporated. 2) Review power plant emergency program. 3) Verify that an emergency response plan is incorporated into the power plant facility operations by periodically inspecting the plant.	1) Review final design and construction specifications prior to the construction period. 2) Periodically inspect power plant to verify that an emergency response plan is incorporated into the power plant facility operations.

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MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
situation. (C, O)				
4.15.3b In the event of a blowout, Calpine shall take immediate corrective action in accordance with BLM regulations to control the release of geothermal fluids, steam, and gases. (C, O)	1) Calpine will control geothermal fluids, steam, and gases in the event of a blowout.	BLM and USFS	1) Monitor the site when a blowout occurs to ensure the BLM regulations are implemented.	1) Monitor the site during blowouts.
4.15.5a Prior to the commencement of construction activities, a fire contingency plan shall be developed by Calpine. The plan shall include information on fire control and fire notification procedures, personnel evacuation plans, fire prevention procedures, and emergency water source locations. The plan shall incorporate procedures to ensure that vendor vehicles would carry fire extinguishers, shovels, and buckets. And, the construction contractor on behalf of the Calpine, shall ensure that the plan is read, understood, and abided by all persons involved with the physical development of the project, especially persons working on-site. (C, O)	1) Calpine will develop a fire contingency plan. 2) Calpine will ensure that the plan includes information on fire control and fire notification procedures, personnel evacuation plans, fire prevention procedures, and emergency water source locations; ensure that vendor vehicles would carry fire extinguishers, shovels, and buckets. 3) Calpine will incorporate the measures from the plan into construction specifications. 4) Calpine will ensure that the plan is read, understood, and abided by all persons involved with the physical operation of the project.	USFS	1) Review and approve the plan and construction specifications.. 2) Monitor the site to verify that items outlined in the plan are implemented on site.	1) Review plan and construction specifications prior to construction. 2) Monitor during construction activities and operation.
4.15.5b To minimize the risk of fire hazard, Calpine shall prepare a Fire Prevention and Suppression Plan as part of the Fourmile Hill fire contingency plan. This plan shall be acceptable to the USFS, BLM, and Modoc and Siskiyou Counties. The plan shall meet the guidelines set forth by the California Department of Forestry's Industrial Operations Fire Prevention Guide. (C, O, D)	1) Calpine will prepare a Fire Prevention and Suppression Plan. 2) Calpine will submit this plan to the USFS, BLM, and Modoc and Siskiyou Counties. 3) Calpine will ensure that the plan meets the guidelines set forth by the California Department of Forestry's Industrial Operations Fire Prevention Guide.	USFS, BLM, Modoc and Siskiyou Counties	1) The responsible agencies will review the plan to ensure it meets guidelines. 2) USFS will monitor the site to ensure plan is being implemented.	1) Prepare, review and approve prior to construction. 2) USFS will monitor the site periodically to ensure plan is being implemented.
4.15.5c Calpine shall ensure that all construction equipment will be equipped with fire potential reduction gadgets, such	1) Calpine will ensure that all construction equipment will be equipped with fire potential	USFS	1) Review construction specification to ensure measure has been incorporated.	1) Review construction specifications to ensure measure has been incorporated prior to

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
as but not limited to spark arresters, mufflers, etc. (C, O, D)	reduction gadgets, such as but not limited to spark arresters, mufflers, etc. 2) Calpine will incorporate this measure into construction specifications.		2) Monitor the site to ensure that equipment is placed with the proper gadgets to reduce the potential for fire.	construction activities. 2) Monitor construction equipment periodically during all phases of the project.
4.15.5d Calpine shall store the chemicals which pose a fire hazard and are associated with plant maintenance and the laboratory in areas which would be constructed of non-flammable, flame retardant material, such as a rigid, steel frame structure with steel panel walls and steel roof. (O)	1) Calpine will ensure that chemicals which pose a fire hazard and are associated with plant maintenance and the laboratory are stored in areas which would be constructed of non-flammable, flame retardant material, such as a rigid, steel frame structure with steel panel walls and steel roof.	USFS	1) Monitor sites to ensure that hazardous materials are stored in the appropriate areas.	1) Monitor site periodically to ensure chemicals are stored in safe areas.
4.15.5e Calpine shall equip the project facility with a comprehensive fire protection system. This would include detection alarm, and suppression and extinguishing capabilities. These specific detection systems should automatically discharge the extinguishing agent and sound the alarm. (C, O, D)	1) Calpine will coordinate with the design engineer to ensure a detection alarm, and suppression and extinguishing capabilities exist at the project facility. 2) Calpine will incorporate this measure into the final design.	USFS	1) Review the final design to ensure that the measure has been incorporated. 2) Inspect the project site to check that a detection alarm and suppression and extinguishing capabilities exist at the site.	1) Review final design plans, prior to construction. 2) During construction of facilities inspect site to ensure this system is incorporated.
4.15.5f Calpine shall coordinate with the USFS to clear vegetation for proper fire control. The clearing requirements shall include, but not be limited to: 1) a fifty (50) foot firebreak around the power plant; and 2) vegetative clearing and maintenance by Calpine along the transmission line during project operation in accordance with California General Order No. 95. (C, O, D)	1) Calpine will coordinate with the USFS to clear vegetation for proper fire control.	USFS	1) Inspect site during vegetation clearing to ensure that clearing requirements are adhered to.	1) Monitor any vegetation clearance during the lifetime of the project.
4.15.8a Calpine shall post public notices at access points to the wellfield and power plant area to notify the public of potential risks associated with using the immediate project area for hunting and recreational purposes. Calpine shall ensure public notices remain intact throughout the life of the project. (C, O, D)	1) Calpine will post public notices at access points to the wellfield and power plant area to notify the public of potential risks associated with using the immediate project area for hunting and recreational purposes.	USFS	1) Monitor site for public notices. 2) Ensure public notices remain intact throughout the life of the project.	1) Prior to the construction. 2) Periodically check notices throughout the life of the project.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
4.15.8b Calpine shall post "no shooting" signs in the vicinity of the power plant and wellfield area and ensure those signs remain posted during the entire length of the project. (C, O, D)	1) Calpine will post no shooting signs in the vicinity of the power plant and wellfield area. 2) Calpine will ensure the signs remain intact.	USFS	1) Monitor site for the placement of no shooting signs. 2) Ensure that signs remain intact throughout the life of the project.	1) Prior to construction. 2) Periodically check signs throughout the life of the project.
SOCIOECONOMICS				
4.16.3a Calpine shall facilitate the transfer of information about short-term housing opportunities between local businesses and individuals providing housing for construction workers by installing a bulletin board and housing availability file in the construction office.	1) Calpine will install a housing availability bulletin board and file in the construction office.	USFS	1) Inspect construction office to verify presence of housing availability bulletin board and file.	1) Inspect construction office at least once per summer construction season.
4.16.7a Calpine shall establish an emergency response facility at the plant site to assist the USFS fire organizations in emergency response. The facility shall include the equipment necessary to provide a first-response to emergency situations at the plant site until the arrival of the USFS fire organizations. (C, O, D)	1) Calpine will establish an emergency response facility at the plant site with the equipment necessary to provide a first-response to emergency situations until the arrival of the USFS fire organizations.	USFS	1) Inspect emergency response facilities and equipment to verify their adequacy.	1) Inspect emergency response facilities and equipment annually during the construction, operation, and decommissioning phases.
4.16.7b Calpine shall provide Level A equipment (protective suits, breathing equipment) to respond to hazardous materials spills. (C, O, D)	1) Calpine will provide Level A equipment to respond to hazardous materials spills.	USFS	1) Inspect plant facilities to verify the availability of Level A equipment.	1) Inspect plant facilities to verify the availability of Level A equipment annually during the construction, operation, and decommissioning phases.
4.16.7c Calpine shall implement a comprehensive safety program at the plant facility, including safety training for all plant personnel. (C, O, D)	1) Calpine will implement a comprehensive safety program at the plant facility, including safety training for all plant personnel.	USFS	1) Calpine will inform the USFS prior to all safety training and will submit outlines and attendance sheets following training.	1) Periodically attend safety training to ensure that they provide adequate safety information to staff.
4.16.7d Calpine shall ensure that at least one person during each of the three project phases is trained in basic emergency medical aid, such as wound treatment, bandaging, and cardiopulmonary resuscitation (CPR), in order to respond to potential on-site injuries. (C, O, D)	1) Calpine will ensure that at least one person during each of the three project phases is trained in basic emergency medical aid, in order to respond to potential on-site injuries. 2) Calpine will annually submit to the USFS, verification that this	USFS	1) Review information submitted by Calpine to verify that measure is being implemented.	1) Review information annually.

Table 5.1-1: Mitigation Monitoring and Reporting Program

MITIGATION MEASURE	IMPLEMENTATION PROCEDURE	RESPONSIBLE AGENCY	MONITORING AND REPORTING ACTIONS	MONITORING SCHEDULE
	measure is being implemented (e.g., CPR certification).			
4.16.7e Calpine shall contract with a private security company to supply guards at the power plant facility. (O)	1) Calpine will contract with a private security company to supply guards at the power plant facility.	USFS	1) Monitor the power plant facility to verify that a private security company is providing protective services to the facility.	1) Monitor the security at the power plant facility annually.
4.16.9a Calpine shall establish a waste reduction program at the plant site to minimize the solid waste stream going to the landfill. (C, O, D)	1) Calpine will develop and implement a waste reduction program at the plant site.	USFS	1) Monitor activities at the power plant to verify that the waste reduction program is being implemented.	1) Monitor activities at the power plant in regards to the waste reduction program annually.

6:
LIST OF PREPARERS AND AGENCIES AND PERSONS CONTACTED

6: LIST OF PREPARERS AND AGENCIES AND PERSONS CONTACTED

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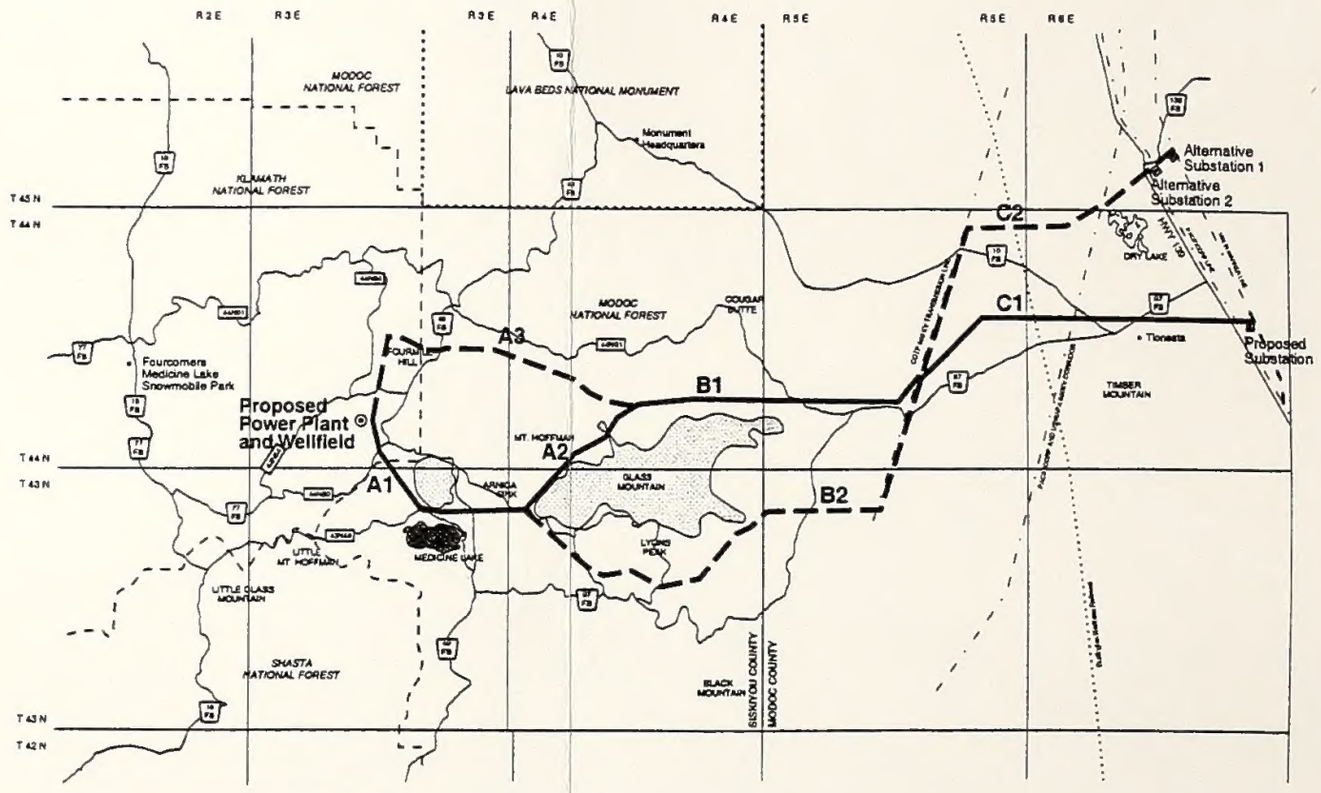
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Fourmile Hill Geothermal Development Project



PROPOSED ACTION (ALTERNATIVE 1)
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ALTERNATIVE 2
A1 —> A2 —> B1 —> C2

ALTERNATIVE 3
A1 —> B2 —> C1

ALTERNATIVE 4
A1 —> B2 —> C2

ALTERNATIVE 5
A3 —> B1 —> C1

ALTERNATIVE 6
A3 —> B1 —> C2

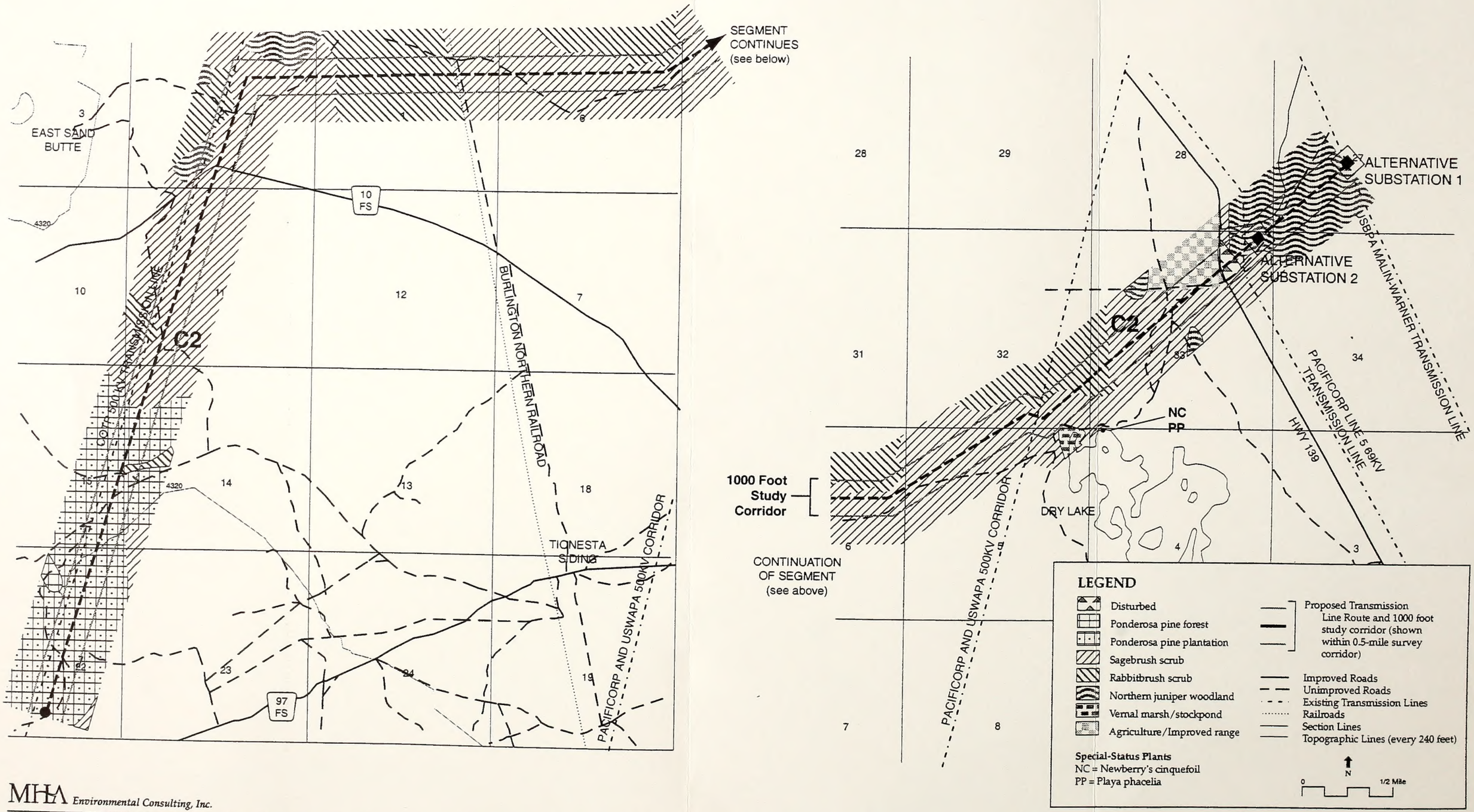
Proposed Transmission Line Route
Alternative Transmission Line Route Segments

N

0 2 4 MILES

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Figure 3.7-8: Vegetation Resources Along Alternative Transmission Line Segment C2





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